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July 15, 1988

Energy Research Abstracts

Abstracts 28800-29832

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UNITED STATES DEPARTMENT OF ENERGY

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ENERGY RESEARCH ABSTRACTS

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Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. **The user should remain aware that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.**

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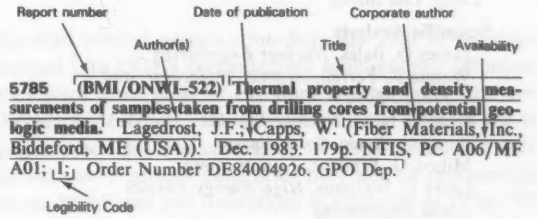
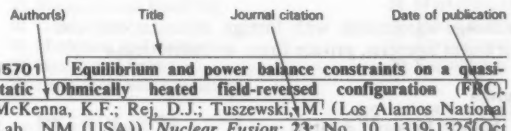
The principal elements of abstract entries for a typical research and development report and a typical technical journal article are illustrated below.



5785 (BMI/ONWI–522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media. Lagedrost, J.F.; Capps, W. (Fiber Materials, Inc., Biddeford, ME (USA)). Dec. 1983. 179p. NTIS, PC A06/MF A01; 1; Order Number DE84004926. GPO Dep.

Density, steady-state conductivity, enthalpy, specific heat, heat capacity, thermal diffusivity and linear thermal expansion were measured on 59 materials from core drill samples of several geologic media, including rock salt, basalt, and other associated rocks from 7 potential sites for nuclear waste isolation. The measurements were conducted from or near to room temperature up to 500°C, or to lower temperatures if limited by specimen cracking or fracturing. Ample documentation establishes the reliability of the property measurement methods and the accuracy of the results.



15701 Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC). McKenna, K.F.; Rej, D.J.; Tuszewski, M. (Los Alamos National Lab., NM (USA)). *Nuclear Fusion;* **23:** No. 10, 1319-1325 (Oct 1983).

Abstract

Zero-dimensional power balance calculations are performed for a quasi-static, purely Ohmically heated field-reversed configuration. Without compression, the constraint imposed by radial pressure balance limits the power input. Estimates of the energy loss from impurity line radiation as well as from classical and anomalous transport are given. Effects of cold puff gas injection are also investigated.

INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA).* Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

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Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

5785 (BMI/ONWI–522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media. Lagedrost, J.F.; Capps, W. **(Fiber Materials, Inc., Biddeford, ME (USA)).** Dec. 1983. 179p. NTIS Order Number DE84004926. GPO Dep.

is indexed as:

Fiber Materials, Inc., Biddeford, ME (USA)

• Personal Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Capps, W., *See* Lagedrost, J. F.
Lagedrost, J.F., Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
McKenna, K.F., Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;US)
Rej, D.J., *See* McKenna, K.F.
Tuszewski, M., *See* McKenna, K.F.

• Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

SALT DEPOSITS
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Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
REVERSED-FIELD PINCH
Energy Balance
Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;AT)

• Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

AC06-76RL01830	**Fiber Materials, Inc., Biddeford, ME (USA)**	
	9:5785	BMI/ONWI–522

• Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. Patents and conference papers are indexed here as a matter of convenience. When a report is supplied under an Order Number, that number is included in the availability statement. An Order number–report number correlation is included for convenience.

BMI/ONWI–522	9:5785	NTIS, PC A09/MF A01. Order Number DE84004926, Distribution Category MN-70

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IEA Coal Research
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ENERGY RESEARCH ABSTRACTS

01 COAL AND COAL PRODUCTS

0103 Preparation

28800 **(CONF-870523—6) Factors affecting coal solubilization by the bacterium Streptomyces setonii 75Vi2 and by alkaline buffers.** Strandberg, G.W.;Lewis, S.N. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 14p.

From 9. symposium on biotechnology for fuels and chemicals; Boulder, CO, USA (5 May 1987).

Streptomyces setonii 75Vi2 produces an extracellular coal-solubilizing component(s) in the absence of coal. The heat stability, relatively low molecular weight, and insensitivity to proteases of the substance(s) responsible for coal solubilization indicate that the mechanism is nonenzymatic. This report describes factors affecting the production and activity of this substance(s) and the similarity in action to alkaline buffer solutions in solubilizing coal.

28801 (EPRI-AP—5460-SR, pp 5.1-5.24) **Coal upgrading by selective agglomeration.** Pawlak, W.; Turlak, A.; Briker, Y.; Ignasiak, B. (Alberta Research Council, Edmonton (Canada)). Feb 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920202/JAW. (CONF-8705261—).

From 12. annual EPRI contractors' conference on fuel science and conversion; Palo Alto, CA, USA (13 May 1987).

Laboratory-scale research conducted at the Alberta Research Council and supported by US Electric Power Research Institute on beneficiation of coals by oil agglomeration has resulted in the development of AGLOFLOAT and AGFLOTHERM processes. This paper summarizes the results of agglomeration studies of American and Canadian coals of different ranks, and describes the results of work on desulfurization and deashing of coals by the AGLOFLOAT process, utilization of tar refuse in oil agglomeration, and oil recovery from agglomerates by the AGFLOTHERM process.

0104 Processing

REFER ALSO TO CITATION(S) 28834, 28841, 28842, 29290, 29306

28802 **(DOE/FE/55014—T28) Great Plains Coal Gasification Project:.** (ANG Coal Gasification Co., Beulah, ND (USA)). 29 Jan 1988. Contract FM02-82FE55014. 92p. NTIS, PC A05; GPO Dep. Order Number DE88007594/JAW.

This progress report on the Great Plains Coal Gasification Project discusses Lignite coal, natural gas, and by-products production as well as gas quality. A tabulation of raw material, product and energy consumption is provided for plant operations. Capital improvement projects and plant maintenance activities are detailed and summaries are provided for environmental, safety, medical, quality assurance, and qualtiy control activities.

28803 **(DOE/PC/70780—T9) Trifunctional catalysts for conversion of syngas to alcohols: Thirteenth quarterly report, September 1, 1987-November 30, 1987.** Bischoff, K.B.;Manogue, W.H.;Mills, G.A.;Bhore, N. (Delaware Univ., Newark (USA). Center for Catalytic Science and Technology). 15 Feb 1988. Contract FG22-84PC70780. 20p. NTIS, PC A03. Order Number DE88007203/JAW.

The problem of separation of the reaction kinetics for carbon monoxide hydrogenation for the synthesis of primary and secondary products was investigated for molybdena modified rhodium/alumina catalysts. A new mathematical method (Delplot) for separating primary/secondary products was found. The utility of this approach is in the easy method of finding the effect of process parameters (GHSV, CO/Hydrogen, Pressure) on the reaction pathway. Furthermore, this method is used to separate regimes of space time (conversion) where a certain product is primary or secondary. The results of the ongoing investigation of particle size and spatial distribution of various components using TEM and XRD are discussed. 1 ref., 11 figs.

28804 **(DOE/PC/90013—T4) Optimum catalytic process for alcohol fuels from syngas: Fourth quarterly technical progress report, October-December 1987.** (Union Carbide Corp., South Charleston, WV (USA). Solvents and Coatings Materials Div.). 29 Jan 1988. Contract AC22-86PC90013. 63p.

Research has been continued on the novel low pressure methanol homologation system. Recent results demonstrate that the ruthenium component serves to hydrogenate an acetaldehyde intermediate to ethanol. The acetaldehyde is formed in a rate and selectivity determining step from methanol by one of the essential catalyst components. Any future improvements in total ethanol selectivity or rate must therefore center around this component. With this idea in mind, new promoters and additives have been examined, but to date no improvements have been made. In our continuing investigations of the direct conversion of syngas to alcohols with homogeneous ruthenium catalysts, lithium iodide was found to be a better source of halide for promoting activity and selectivity to higher alcohols. It is also apparent that the concentrations of LiI and another of the catalyst additives are important factors in determining the activity and selectivity of a catalyst system. The C_2^+ alochol fraction produced in most of these experiments with the homogeneous ruthenium system is largely composed of ethanol. Alcohol mixtures with a higher C_2^+ content would be more desirable for use as motor fuel extenders. Recently, we attempted to increase the production of C_2^+ alcohols by using a certain catalyst additive. Although the results are preliminary, there is an indication that C_2^+ alcohol production can generally be increased. Process economics for a base case for producing fuel alcohols from natural gas and coal have been developed. The base case uses only existing commercially demonstrated technologies. The cost of producing fuel alcohols is estimated to be 105 centsgal starting with syngas from natural gas reforming, 108 centsgal with syngas from natural gas partial oxidation, and 149 centsgal from goal. Based on a conceptualized process the lowest cost at which fuel alcohols can be produced is about 70 centsgal. 9 figs., 12 tabs.

28805 (EPRI-AP—5460-SR, pp 3.1-3.24) **Progress in biological conversion of low rank coals.** Wilson, B.W.; Pyne, J.W.; Bean, R.M.; Stewart, D.L.; Lucke, R.B.; Thomas, B.L.; Thomas, M.T.; Campbell, J.A.; Cohen, M.S. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Feb 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920202/JAW. (CONF-8705261—).

From 12. annual EPRI contractors' conference on fuel science and conversion; Palo Alto, CA, USA (13 May 1987).

Substantial progress has been made during the last year in understanding the phenomenon of coal solubilization by fungi and bacteria. Screening of additional organisms for biosolubilization capability, and screening of coals for amenability to biosolubilization continues. Chemical characterization of the initially obtained biosolubilized product has been completed. Work by the BNW/Hartford group over the last several months has focused primarily on the development and use of cell-free enzyme extracts to solubilize lignite coals. Enzymes from Polyporous versicolor, responsible for solubilization of lignite, have been isolated and characterized. Model

compounds have been used to study the catalytic capabilities of these enzymes. Results from these studies were compared to those using intact P. versicolor and Phanetochaete chrysosporium. Additional bioreactor studies have been done, and a conversion metric has been developed to compare conversions obtained from different organisms on various coals.

28806 (EPRI-AP—5460-SR, pp 4.1-4.16) **Progress report on the selective oxidation of pyrites in coals.** Tewksbury, T.L.; Carlton, H.E.; Oxley, J.H. (Battelle Columbus Labs., OH (USA)). Feb 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920202/JAW. (CONF-8705261—).

From 12. annual EPRI contractors' conference on fuel science and conversion; Palo Alto, CA, USA (13 May 1987).

A process is being developed to remove pyritic sulfur from coal by selective oxidation at relatively low temperatures in a fluidized-bed system. Essentially all the pyritic sulfur, and perhaps some of the sulfate sulfur as well, can be removed from non-caking or weakly caking steam coals ground to less than about 20 mesh at temperatures of about 725-775 F and at steam to air ratios of about 10 to 1. Heating value loss is in the range of 5 to 20%. The product coal is not pyrophoric and can be discharged relatively hot from the reactor apparently without significant further oxidation. Up to at least about 4% SO_2 in the fluidizing feed gas causes no significant reduction in SO_2 removal kinetics. Work is now underway to study continuous feeding and discharge operation as compared to the batch operation previously employed. The process may be especially suitable as an alternative to the fine coal cleaning circuits in conventional coal cleaning plants.

28807 (EPRI-AP—5460-SR, pp 6.1-6.18) **Potential improvements in methanol synthesis.** Lee, S.; Parameswaran, V.R.; Sawant, A.V.; Ko, M.K. (Univ. of Akron, OH (USA)). Feb 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920202/JAW. (CONF-8705261—).

From 12. annual EPRI contractors' conference on fuel science and conversion; Palo Alto, CA, USA (13 May 1987).

Technology for the catalytic synthesis of methanol has been available for almost a century. As a result of persistent research, primarily in catalyst development, several vapor phase processes were developed and commercialized. Catalysts with higher activities were developed, until finally it appeared that further enhancement would not be feasible because of the increasing rate of heat generation which in turn damaged the catalyst itself. As a consequence, the liquid phase methanol (LPMeOH) process was developed. The current work provides an overview of methanol synthesis and focuses on the areas where improvements are possible. Even though the experiments have been conducted on the liquid phase methanol synthesis process, the scientific findings with regard to the methanol synthesis chemistry and enhancement of catalyst life are applicable to vapor phase processes as well. Special attention has also been given to the unique problems of mass transfer that hamper the development of the LPMeOH process.

28808 (EPRI-AP—5460-SR, pp 7.1-7.14) **Update of low temperature catalyst development.** Mahajan, D.; Sapienza, R.S.; O'Hare, T.E.; Skaperdas, G. (Brookhaven National Lab., Upton, NY (USA)). Feb 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920202/JAW. (CONF-8705261—).

From 12. annual EPRI contractors' conference on fuel science and conversion; Palo Alto, CA, USA (13 May 1987).

A highly active catalyst system for the synthesis of methanol from synthesis gas has been under development at Brookhaven National Laboratory (BNL). A combination of low temperature, low pressure, and liquid phase performance makes it possible to achieve high conversion per pass, typically > 90% with feed gas composed of hydrogen to carbon monoxide ratio of 2 with this new catalyst. High selectivity to methanol (> 95%) has been routinely achieved with methyl formate, a value added product, being the by-product. Batch runs indicate that in addition to temperature and pressure, activity of the new catalyst is sensitive to catalyst formulation, solvent medium, and concentration of product methanol. The catalyst is inert to most impurities normally present in coal-derived syngas, although the carbon dioxide to carbon monoxide ratio is a critical factor. A continuous unit, presently under construction, is described. The purpose of the unit, and the planned runs to demonstrate the feature of the catalyst, are discussed.

28809 (EPRI-AP—5460-SR, pp 8.1-8.29) **Once-through methanol (OTM) technology, economics, and demonstration.** Bradshaw, D.T.; Weatherington, R.W.; Wright, T.L. (Tennessee Valley Authority). Feb 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920202/JAW. (CONF-8705261—).

From 12. annual EPRI contractors' conference on fuel science and conversion; Palo Alto, CA, USA (13 May 1987).

The Once-Through Methanol (OTM) concept offers electric utilities a secure source of a clean, coal-derived liquid fuel. Electric utilities have an enormous need for a secure replacement of oil and natural gas for their combustion turbines, combined cycle plants, and boilers. OTM provides a fuel grade (crude) methanol for internal replacement of oil and natural gas and a higher valued, chemical-grade methanol for sale as part of a diversification strategy. Environmentally, OTM improves Integrated Gasification/Combined Cycle's (IGCC) already significant advantage over conventional coal-fired capacity with further reductions in SO_2 emission. Economically, OTM will ensure high-load factors for new IGCC plants and provide a higher valued by-product than a utilities' replacement energy cost. These two factors can produce up to a 22% reduction in first year revenue requirements compared to new pulverized coal-fired capacity. The proposed OTM project at TVA would demonstrate methanol coproduction in a Texaco gasification plant simulating IGCC operation through the partial conversion of a coal derived CO-rich synthesis gas. The 35 t/d Liquid Phase Methanol (LPMEOH) demonstration and slipstream gas-phase test units will provide the necessary design basis and operating data for commercializing OTM technology.

28810 (EPRI-AP—5460-SR, pp 9.1-9.12) **Stability and selectivity of potassium promoted iron catalyst in slurry Fischer-Tropsch synthesis.** Zarochak, M.F.; McDonald, M.A.; Rao, V.U.S. (Dept. of Energy, Pittsburgh, PA (USA)). Feb 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920202/JAW. (CONF-8705261—).

From 12. annual EPRI contractors' conference on fuel science and conversion; Palo Alto, CA, USA (13 May 1987).

Pretreatment of a precipitated iron catalyst impregnated with potassium carbonate was found to strongly influence the catalyst's activity, activity maintenance, and selectivity maintenance. The 0.29% K catalyst induced for 24 hours at synthesis conditions (1/1 H_2/CO, 200 psig, 260°C) initially gave (H_2 + CO) conversions of 61% during synthesis, but this activity declined threefold over the next 300 hours. In contrast, following a 24 hour pretreatment at 280°C in CO, (H_2 + CO) conversions initially approached the maximum attainable, and these (H_2 + CO) conversions declined very slowly. Catalyst selectivity maintenance was also improved by CO pretreatment. With the induced catalyst, selectivity shifted towards less desirable lighter hydrocarbons as the catalyst deactivated. With the CO-pretreated catalyst, selectivity to light hydrocarbons, although initially high, was, after several days, essentially the same as with the induced catalyst.

28811 (EPRI-AP—5460-SR, pp 11.1-11.16) **Coal liquefaction catalyst deactivation.** Tait, A.M.; Pacheco, M.A.; Sajkowski, D.I. (Amoco Oil Co., Naperville, IL (USA)). Feb 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920202/JAW. (CONF-8705261—).

From 12. annual EPRI contractors' conference on fuel science and conversion; Palo Alto, CA, USA (13 May 1987).

Three spent catalysts from a coal liquefaction pilot plant at Amoco have been extensively characterized in order to understand the causes of catalyst deactivation. X-ray photoelectron spectroscopy and NO chemisorption data indicate a good correlation between exposed metals (Co and Mo) and distillate yield. Controlled oxidation of the catalysts at increasing temperatures coupled with measurements of the surface composition by XPS suggest the loss of exposed metal is due to carbon coverage. Sintering, observed by TEM and electron microprobe, may also play a role. An analysis of

the deposited carbon by core-energy electron loss spectroscopy, temperature-programmed oxidation, and C^{13} NMR suggests sp^2 carbon increases from the topmost surface layers of carbon into the bulk and that the surface aromatic carbon is related to distillate yield. BET surface areas and pore volumes of spent catalysts from three different pilot plants, including HRI and Wilsonville, were also found to correlate well with the bulk carbon content irrespective of the processing conditions.

28812 (EPRI-AP—5460-SR, pp 12.1-12.36) **Wilsonville kinetic models and ITSL simulation.** Prasad, A.; Nalitham, R.V.; Pinkston, T.E. Feb 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920202/JAW. (CONF-8705261—).

From 12. annual EPRI contractors' conference on fuel science and conversion; Palo Alto, CA, USA (13 May 1987).

Material balance only simulations have been performed for the Integrated Two-Stage Liquefaction (ITSL) process using the ASPEN process simulator, Illinois No. 6 bituminous coal liquefaction was considered. All the recycle streams were converged and user-defined reactor models were interfaced with ASPEN. Reactor models have been developed for the thermal and catalyst reactors. A Critical Solvent Deashing Unit (CSD) correlation have been developed to predict the organic rejection in the ash concentrate, and ITSL simulations. Sensitivity analysis has been performed for the ITSL process.

28813 (EPRI-AP—5460-SR, pp 14.1-14.15) **Assessing the economic impact of two-stage liquefaction process improvements.** Gray, D.; Tomilson, G. (Mitre Corp. (USA)). Feb 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920202/JAW. (CONF-8705261—).

From 12. annual EPRI contractors' conference on fuel science and conversion; Palo Alto, CA, USA (13 May 1987).

The economic impact of demonstrated and projected improvements in two stage direct liquefaction processes are evaluated. The computerized methodology employed estimates the quantity and quality of products from a 30,000 ton/day commercial scale plant, based on input test data. Steam, hydrogen and fuel gas balances are determined. Capital and operating costs are then estimated, and the required selling price of raw liquid products are determined by conventional DCF analysis. Product quality is quantified by computing the cost of upgrading the raw products to motor gasoline. Improvements in two stage processing since the early demonstration of the Lummus Integrated Two Stage (ITSL) process in 1980 are shown to reduce the required initial selling price (RISP) of gasoline from coal liquids by about 16%. Further process improvements which offer the potential for an additional 15% RISP reduction are identified.

28814 (EPRI-AP—5460-SR, pp 15.1-15.17) **Coal/oil co-processing program update.** Duddy, J.E.; McLean, J.B.; Smith, T.O. (Hydrocarbon Research, Inc. (USA)). Feb 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920202/JAW. (CONF-8705261—).

From 12. annual EPRI contractors' conference on fuel science and conversion; Palo Alto, CA, USA (13 May 1987).

Hydrocarbon Research, Inc. (HRI) is developing an advanced catalytic two-stage process to liquefy coal while simultaneously upgrading heavy crudes or petroleum residua. The development of the HRI Coal/Oil Co-Processing Technology is being sponsored by the Electric Power Research Institute (EPRI), Ontario Ohio Synthetic Fuels Corporation, Ltd. (OOSFC), Alberta Research Council (ARC) and DynCorp. The State of Ohio's Coal Development Office has supported the program through OOSFC. This ongoing coal/oil co-processing program is separated into two phases. Phase 1, completed in 1986, evaluated the technical, economic and commercial feasibility of coal/oil co-processing. Phase 2, which is currently in progress, is focused on process demonstration, evaluation of alternative feedstocks and improving process understanding. In addition to this ongoing technology development program, the HRI Coal/Oil Co-Processing Technology has been selected for use in a Prototype Commercial Coal/Oil Co-Processing Plant. This project, which was one of nine selected by the US Department of Energy (DOE) for support under their clean coal technology solicitation, is scheduled to start up in 1991 and will be located in Warren, Ohio. Agreements on this project are currently being negotiated with DOE. This paper presents an updated summary on the status of these activities.

28815 (EPRI-AP—5460-SR, pp 16.1-16.35) **Update: Lummus co-processing project and results of catalyst activity maintenance testing.** Greene, M.; Gupta, A.; Moon, W. (Lummus Crest, Inc., Bloomfield, NJ (USA)). Feb 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920202/JAW. (CONF-8705261—).

From 12. annual EPRI contractors' conference on fuel science and conversion; Palo Alto, CA, USA (13 May 1987).

Lummus Crest Inc. (LCI) has been performing an R & D program under joint funding with the DOE to determine the technical and economic feasibility of LCI's co-processing concept. The latter consists of a two-stage (thermal-catalytic), close-coupled reaction system in which the petroleum feedstock can be introduced into either of the two stages. In the standard mode, an externally hydrogenated petroleum feedstock, such as the unconverted vac bottoms from an expanded-bed hydrocracker (e.g., LC-Fining process), serves as the slurry paste for the feed coal to the short contact time (SCT), thermal-stage reactor. In the alternative mode, a virgin (or externally hydrogenated) petroleum feedstock is injected into the close-coupled catalytic stage and unconverted, but hydrogenated vac bottoms from this catalytic stage are recycled to the thermal stage as a slurry paste for the feed coal. Two extended catalyst activity maintenance tests were made in a continuous 50 pound/day bench-scale unit: one in the standard mode with commercial petroleum-derived hydrocracker vac bottoms from Amoco Oil's Texas City LC-Fining unit; and one in the alternative mode with Arab Heavy vac resid. Both tests used Pittsburgh seam Ireland Mine coal. Results of the standard mode activity maintenance test are presented in this paper along with the design basis and preliminary results of the conceptual plant design study.

28816 (EPRI-AP—5460-SR, pp 18.1-18.21) **Continuous bench-scale testing of co-processing.** Luebke, C.P.; Humbach, M.J.; Gatsis, J.G.; Nelson, B.J.; Lea, C.L. (UOP, Inc. (USA)). Feb 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920202/JAW. (CONF-8705261—).

From 12. annual EPRI contractors' conference on fuel science and conversion; Palo Alto, CA, USA (13 May 1987).

The UOP single-stage slurry catalyzed process was demonstrated in batch and continuous pilot plant operations. The results from the batch reactivity study are reviewed and include a process variable study, catalyst study and a feedstock sensitivity study. Six different petroleum resids, four different coals and two different catalyst systems were tested. Continuous bench scale tests were conducted using blends of Lloydminster vacuum resid with Illinois Coal No. 6 and Wyodak coal. The long term operability of the process was demonstrated with a 12-week test run using Illinois Coal No. 6 and Lloydminster vacuum resid. The run plots from this test run are presented.

28817 **Effect of Si/Al ratio on secondary reactions during CO hydrogenation on zeolite-supported metal catalysts.** Oukaci, R.; Wu, J.C.S.; Goodwin, J.G. Jr. (Univ. of Pittsburgh, PA (USA)). *Journal of Catalysis;* **110**: No. 1, 47-57(Mar 1988). Contract FG22-83PC60805.

The effect of zeolite acidity on the product distribution in CO hydrogenation over ion-exchanged zeolite-supported Ru catalysts was investigated using zeolites with different Si/Al ratios. CO hydrogenation over RuNaX, RuNaY, RuKL, and RuNa-mordenite and the transformation of 1-butene on the zeolites without the metal, under conditions similar to those used for CO hydrogenation, were investigated in order to understand the effect of zeolite acidity on possible secondary reactions of the primary olefinic products of Fischer-Tropsch (F-T) synthesis. The results of this study establish the importance of the bifunctional nature of the zeolite-supported F-T catalysts in modifying catalyst selectivity. This modification is achieved as a result of secondary reactions of the primary olefinic F-T products on the acid sites of the zeolite, generated during catalyst preparation. Depending on the strength of the acid sites, a function of the Si/Al ratio, various competitive re-

action paths can be observed for the transformation of the olefinic compounds. 30 references.

28818 Controlled atmosphere electron microscopy study of the gasification of graphite by water, hydrogen, and oxygen catalyzed by a nickel/potassium mixture. Carrazza, J.; Chludzinski, J.J. Jr.; Heinemann, H.; Somorjai, G.A.; Baker, T.K. (Lawrence Berkeley Lab., CA (USA)). *Journal of Catalysis;* **110**: No. 1, 74-81(Mar 1988). Contract AC03-76SF00098.

The gasification of graphite by H_2O vapor, wet H_2, and wet O_2, catalyzed by a Ni/K mixture is studied using controlled atmosphere electron microscopy (CAEM). In H_2O vapor the carbon consumption, between 550 and 1100°C, is catalyzed by an edge recession mode of attack in the [1120] direction, with no sign of deactivation. An activation energy of 30.8 +/- 0.9 kcal/mol is obtained in this case. This value is similar to those obtained in kinetic studies of the steam gasification of both graphite and char, using this catalyst. In wet H_2 both channeling and edge recession occur simultaneously. The activation energy obtained is equal to 30 +/- 2 kcal/mol. The catalyst deactivates above 1000°C, but can be regenerated by treating the sample in H_2 vapor at 600°C. In wet O_2 graphite is also gasified by edge recession, but no preferred direction is observed. The catalyst maintains its activity up to 1000°C, and an activation energy of 25 +/- 2 kcal/mol is obtained. These results show that the catalytic properties of the Ni/K mixture are superior to those of Ni and K alone due to a cooperative effect between the components. 20 references.

28819 Temperature-programmed desorption and infrared study of CO and H_2 adsorption on Cu/ZnO catalysts. Roberts, D.L.; Griffin, G.L. (Univ. of Minnesota, Minneapolis). *Journal of Catalysis;* **110**: No. 1, 117-126(Mar 1988). Contract FG02-85ER13392.

The authors have characterized a series of Cu/ZnO catalysts prepared by several methods, using a combination of adsorbate uptake measurements, temperature-programmed desorption, and FTIR spectroscopy applied to CO, H_2, and O_2 adsorbates. Adsorbed CO is present on the reduced catalysts in several adsorption states which are distinguished by different vibrational frequencies in the range 2104-2067 cm^{-1}, and which desorb with apparent activation energies in the range 10-16 kcal/mol. When CO is adsorbed on oxidized catalysts, the frequencies shift to 2136-2110 cm^{-1} and the highest desorption energy increases to 19 kcal/mol. For H_2 adsorbed on reduced catalysts, a single desorption state which has an apparent activation energy of 20-21 kcal/mol is observed. When H_2 is adsorbed on oxidized catalysts, the desorption energy of this state increases to 26-27 kcal/mol. For the reduced catalysts, the amounts of reversible CO and H_2 adsorbed are found to correlate linearly with the amount of O_2 chemisorption measured at 98 K, with relative uptakes for CO, H_2, and O_2 in the ratio 9:2:10. These results are interpreted to suggest that Cu is present as metallic clusters which expose a large fraction of high-index surface planes and that the chemical behavior of these planes is significantly differed from that of low-index single crystal planes. 38 references.

28820 Isosynthesis reactions of CO/H_2 over zirconium dioxide. Tseng, S.C.; Jackson, N.B.; Ekerdt, J.G. (Univ. of Texas, Austin (USA)). *Journal of Catalysis;* **109**: No. 2, 284-297(Feb 1988). Contract AS05-80ER10720;FG05-86ER13604.

The reaction of an equimolar mixture of H_2 and CO was studied over ZrO_2 at 350 to 450°C, 35 atm total pressure, and varying residence times. The isosynthesis reaction mechanisms were studied by monitoring the incorporation of oxygenated compounds into the isosynthesis products. Propionaldehyde and [^{13}C]acetone, [^{13}C]isopropanol, and [^{13}C]methanol were added to the CO/H_2 reactant stream. Their effect on the isosynthesis product distributions and on the isotopic distribution of the products was monitored as a function of oxygenate feed rate. Propionaldehyde, acetone, and methanol were found to incorporate into the isosynthesis products. The isotopic distribution of the products was used to support an isosynthesis reaction scheme that involves CO insertion into a bound aldehyde or ketone as the major chain growth step and a second chain growth step that involves condensation between methoxide and a surface bound enolate. 32 references.

28821 Mechanism for sodium oxide catalyzed CO_2 gasification of carbon. Saber, J.M.; Kester, K.B.; Falconer, J.L.; Brown, L.F. (Univ. of Colorado, Boulder (USA)). *Journal of Catalysis;* **109**: No. 2, 329-346(Feb 1988). Contract FG22-82PC50798.

Temperature-programmed reaction was used to study sodium oxide catalyzed CO_2 gasification of ^{13}C. The stoichiometry of the reaction is $CO_2 + a^{13}C$ equivalent to $CO + (1 - a)^{13}CO_2 + (2a - 1)^{13}CO$, where the factor a is dependent on CO_2 conversion. This stoichiometry is consistent with a mechanism composed of a reversible catalyst oxidation step and an irreversible catalyst reduction step. On the surface the catalytic surface species is oxidized by CO_2 and forms CO; during the reduction reaction the oxidized species decomposes. The reversible oxidation step, which incorporates substrate carbon into gas-phase carbon dioxide, is at equilibrium. Carbon monoxide, via the reverse of the oxidation reaction, inhibits gasification of the substrate by decreasing the number of oxidized catalytic sites on the surface. The catalyst appears both to increase the amount of oxygen on the surface and to decrease the activation energy of the reduction reaction. Similar mechanisms describe potassium- and calcium-catalyzed gasification, but Na_2CO_3 does not interact with the carbon surface as readily as K_2CO_3 does. A similar mechanism is also consistent with steam gasification results reported by others and shows that a separate water-gas shift reaction is not required for CO_2 production. 44 references.

28822 Studies of the interactions of H_2 and CO with Pd/TiO_2 and TiO_2-promoted Pd/SiO_2. Rieck, J.S.; Bell, A.T. (Lawrence Berkeley Lab., CA (USA)). *Journal of Catalysis;* **99**: No. 2, 262-277(Jun 1986). Contract AC03-76SF00098.

The interactions of H_2 and CO with $PdSiO_2$, $PdTiO_2$, and titania-promoted $PdSiO_2$ have been investigated using temperature-programmed desorption and temperature-programmed surface reaction. In the presence of TiO_2, as a support or promoter, a portion of the TiO_2 is reduced to TiO/sub x/ moieties which decorate the surfaces of the Pd particles. These species cause a suppression in chemisorption of H_2 and CO, the magnitude of which is a function of the catalyst reduction temperature. The TiO/sub x/ moieties have little influence on distribution of H_2 adstates but cause a noticeable change in CO adstates. Decoration of Pd by TiO/sub x/ moieties also aids the dissociation of CO, and raises thereby the activity for CH_4 synthesis relative to that for $PdSiO_2$. 58 references.

28823 Studies of the interactions of H_2 and CO with Pd/SiO_2 promoted with La_2O_3, CeO_2, Pr_6O_{11}, Nd_2O_3, and Sm_2O_3. Rieck, J.S.; Bell, A.T. (Lawrence Berkeley Lab., CA (USA)). *Journal of Catalysis;* **99**: No. 2, 278-292(Jun 1986). Contract AC03-76SF00098.

The interactions of H_2 and CO with Pd/SiO_2 promoted with La_2O_3, CeO_2, Pr_6O_{11}, Nd_2O_3, and Sm_2O_3 have been investigated using temperature-programmed desorption and temperature-programmed surface reaction. Introduction of the promoter following the preparation of the Pd/SiO_2 catalyst results in a partial coverage of the Pd particles by the oxide promoter. Upon reduction of the promoted catalysts, portions of the promoter in contact with Pd undergo reduction. The partially reduced rare earth oxide species covering the Pd particles reduce the amounts of H_2 and CO that can be adsorbed on the metal. The rare earth oxide moieties have a slight influence on the distribution of H_2 adstates but cause a significant change in the distribution of CO adstates. Decoration of Pd by rare earth oxide moieties also aids the dissociation of CO, and raises thereby the activity for CH_4 synthesis relative to that for Pd/SiO_2. The promoter also serves to increase the activity for CH_3OH synthesis and the formation of CO_2 via the water-gas shift reaction. 42 references.

28824 Influence of the temperature-ramp on mass transfer effects during temperature-programmed desorption from porous catalysts. Huang, Y.; Schwarz, J.A. (Syracuse Univ., NY (USA)). *Journal of Catalysis;* **99**: No. 1, 249-251(May 1986). Contract AC02-84ER13158.

The influence of mass transfer effects on temperature-programmed desorption (TPD) spectra from porous catalysts has been examined from the standpoints of nondimensional analysis and numerical simulation of specific models. Considerable attention has

been focused on the interaction of H_2 and CO over Group VIII metal supported catalysts. In the absence of mass transfer limitations and under conditions of equilibrium adsorption, reasonably accurate estimates of the enthalpy of adsorption can be obtained using a theoretical relationship, which is independent of the transport model used to describe flow through the porous bed of catalyst. Gorte has proposed that intraparticle concentration gradients can be minimized by reducing catalyst particle size and carrier gas flow rate. This criterion was obtained by nondimensionalization of the differential equations governing mass transfer during TPD and appears to provide a suitable basis for predicting the onset of intraparticle mass transfer effects. This work assumes that this condition is met and considers the applicability of a convenient procedure that has been proposed for mathematically simulating thermal desorption from porous adsorbent particles. This method is an alternative to the dispersion model and introduces the concept of a mixing cell. In such a model, the number of mixing cells in a cascade of mixing cells is chosen such that axial dispersion of gas-phase species is accurately described: as axial dispersion becomes more significant, the number of mixing cells that simulate this dispersion decreases. 13 references.

28825 Transient kinetic observation of chain growth in the Fischer-Tropsch synthesis. Zhang, X.; Biloen, P. (Univ. of Pittsburgh, PA (USA)). *Journal of Catalysis;* **98**: No. 2, 468-476(Apr 1986). Contract AC22-84PC70020.

An abrupt change of the reaction environment from $^{12}CO/H_2$ to $^{13}CO/H_2$ leads to a gradual ingrowth of ^{13}C in hydrocarbons. This rate of ingrowth can be modeled in a manner which is essentially independent of the details of the reaction mechanism. It is calculated that the rate of C-C bond formation varies from $\geqq 1$ s^{-1} (ruthenium) to $\leqq 0.1$ s^{-1} (cobalt). Further findings include the experimental observation of surface heterogeneity and the relatively short residence times for the C_1 monomers involved in chain growth. 29 references.

28826 Effect of niobia on the methanation activity of a Pt foil. Demmin, R.A.; Gorte, R.J. (Univ. of Pennsylvania, Philadelphia (USA)). *Journal of Catalysis;* **98**: No. 2, 577-580(Apr 1986). Contract FG02-85ER13350.

Recent work examining the interaction between titania and transition metals has indicated that a partially reduced titania overlayer can form on the surface of a titania-supported catalyst. In addition, the authors have shown that a Pt foil with a titania overlayer exhibits the same methanation rates as are reported for actual titania-supported Pt catalysts, even though complete suppression of CO and H_2 adsorption is observed. Unusual support effects are observed for metals on niobia as well. As with titania-supported catalysts, catalysts supported on niobia can exhibit suppressed adsorption of CO and H_2 while maintaining a high methanation activity. To determine whether an overlayer of niobia was responsible for the properties observed with niobia-supported catalysts, the authors have examined the methanation activity for a Pt foil with a niobia overlayer. The experimental apparatus consists of a sample attached to a magnetically manipulated, linear-motion feedthrough which can be isolated from an ultrahigh vacuum system. This system allows them to measure reaction rates at atmospheric pressures on a sample which can be characterized by Auger electron spectroscopy (AES) both before and after reaction. This system is described in more detail elsewhere. 22 references.

28827 Catalyst aging studied with isotopic transients: methanation over Raney nickel. Soong, Y.; Krishna, K.; Biloen, P. (Univ. of Pittsburgh, PA (USA)). *Journal of Catalysis;* **97**: No. 2, 330-343(Feb 1986). Contract AC02-83ER13105.

Abrupt changes in the reaction ambient from $^{12}CO/H_2$ to $^{13}CO/H_2$ are utilized to obtain transient-kinetic information regarding the causes of activity decline in the methanation over Raney nickel. From the responses the authors infer that the methanation proceeds via at least two parallel pathways. The relative contribution of the two pathways changes with catalyst aging. The gradual development of a less reactive carbonaceous overlayer alone is insufficient to explain the observations. The authors conclude that aging affects the nickel catalyst itself. 16 references.

28828 Fischer-Tropsch synthesis over reduced and unreduced iron oxide catalysts. Dictor, R.A.; Bell, A.T. (Lawrence Berkeley Lab., CA (USA)). *Journal of Catalysis;* **97**: No. 1, 121-136(Jan 1986). Contract AC03-76SF00098.

An investigation has been carried out of Fischer-Tropsch synthesis over potassium-promoted and unpromoted iron oxide catalysts. The distribution of products over reduced and unreduced Fe_2O_3 are similar. The primary products are methane and linear, terminal olefins. Some C_3^+ paraffins are produced in parallel with olefins, but most result from hydrogenation of the olefins. Isomerization of terminal to internal olefins also occurs as a secondary reaction. The Anderson-Schulz-Flory distribution of products is characterized by two branches differing in the value of α. The average molecular weight of the product increases with decreasing temperature, decreasing H_2 partial pressure, and increasing CO partial pressure. Methanol is the only oxygenated product formed over unpromoted Fe_2O_3. Promotion of Fe_2O_3 with potassium suppresses the rates of olefin hydrogenation and isomerization, and the rate of methanol formation, but enhances the rates of formation of C_5^+ hydrocarbons, branched hydrocarbons, and aldehydes. The kinetics for the synthesis of C_1-C_7 hydrocarbons were determined for both promoted and unpromoted catalysts. The data show that in general the kinetics of formation of an individual product cannot be represented by simple power-law rate expressions. Based on X-ray diffraction analyses of used catalysts, it is concluded that the phase of iron active for Fe_2O_3 Fischer-Tropsch synthesis is a mixture of chi- and epsilon'-iron carbides, and a small amount of α-iron. 39 references.

28829 Iron alloy Fischer-Tropsch catalysts. V. FeCo on Y zeolite. Lin, T.; Schwartz, L.H.; Butt, J.B. (Northwestern Univ., Evanston, IL (USA)). *Journal of Catalysis;* **97**: No. 1, 177-187(Jan 1986).

A series of Fe, Co, and FeCo catalysts on Y-zeolite support, prepared both by ion exchange and impregnation, has been investigated and compared with a previously reported series supported on wide-pore SiO_2. Characterization methods were X-ray diffraction, H_2 and CO chemisorption, Moessbauer spectroscopy, and atomic absorption. The oxidation, reduction, and carburization behavior of the iron-containing catalysts were observed by Moessbauer spectroscopy. The reversibility of FeY (ion exchanged) in oxidation-reduction cycles was confirmed. The ion-exchanged catalysts (FeY, FeCoY) do not show any iron metal, or alloy or carbide phase after reduction or attempted carburization. In contrast with prior results with silica-supported Fe and FeCo, where there appear to be significant differences, Fe/HY (impregnated) and FeCo/HY appear quite similar in characterization by Moessbauer spectroscopy and in reaction behavior. A 1/1:CO/H_2 feed was used to investigate the Fischer-Tropsch reaction at 1 atm and 523 K. Some additional runs were made at a total pressure of 13.6 atm. As in prior studies it was found that the CO turnover frequency in general decreases with increasing CO conversion. A higher selectivity for higher molecular weight products is found for HY-supported catalysts, and in all cases an approximate behavior in accord with the Schultz-Anderson distribution was observed. 23 references.

0105 By-products

REFER ALSO TO CITATION(S) 28802

0106 Properties

REFER ALSO TO CITATION(S) 28840

28830 (DOE/PC/90519—T5) Electrochemical characterization and derivation of coal:. Park, Su-Moon. (New Mexico Univ., Albuquerque (USA). Dept. of Chemistry). 1988. Contract FG22-86PC90519. 5p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88006698/JAW.

In summary, it has been demonstrated that a simple hydrolysis of coal in alkaline media leads to the production of humic acids, the yield of which varies depending on experimental conditions. The hydrolysis yield of coal to produce humic acids increases when: (1) the temperature of the hydrolysis reaction bath is higher,

(2) the coal slurries are washed in acid solutions such as H/sub 2/ SO/sub 4/. Effects of catalysts on hydrolysis reactions of coal was examined employing manganese dioxide. The results are very promising for higher yield of humic acids generation. Approximately 2 g of MnO/sub 2/ were added to the solution containing coal slurries. This procedure improved the yield of humic acids recovery to about 62.0%. In the process of recovering humic acids from hydrolyzed coal, it was reaiized that MnO/sub 2/ is reduced to Mn(II), which complexes strongly with humic acids. The complexed Mn(II) could be removed only by washing the humic acids with strong hydrochloric or sulfuric acid. This indicates that humic acids could be used as a soil conditioner for alkaline soil, since the acids will neutralize soil and also retain minerals. 2 tabs.

28831 **(DOE/PC/90753—T7) Coal ash deposition, interaction with metal substrates and deposit build up:.** Birks, N. (Pittsburgh Univ., PA (USA). Dept. of Materials Science and Engineering). 1988. Contract FG22-86PC90753. 6p.

Experiments have been made using 304 Stainless Steel coated with the furnace ash and exposed for times up to 100 hours and temperatures up to 900 {degree}C in an atmosphere of air {plus} 1 % SO_2. The surface of these specimens have been examined and the specimens have been examined and the specimens have also been examined in cross section using SEM -EDS, optical microscopy and x-ray diffraction. Up to 40 hours at 700 {degree}C, there was no change on the ash surface and no attack of the metal grain boundaries. It was thought that, although equilibrium is achieved in the gas phase, equilibriuim was not being achieved in the reaction tube between the ash and gas mixture. Further experiments wre run for 100 hours, at different temperatures, with and without an ash coating on the substrate in order to make comparisons results are described.

28832 (EPRI-AP—5460-SR, pp 1.1-1.38) **Chemical structural comparison of lignite, subbituminous, and bituminous coal.** Chung, K.E.; Goldberg, I.B. Feb 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920202/JAW. (CONF-8705261—).

From 12. annual EPRI contractors' conference on fuel science and conversion; Palo Alto, CA, USA (13 May 1987).

Chemical structural characteristics of a Texas lignite, a Wyoming subbituminous coal, and an Illinois bituminous coal were compared in terms of the distribution and arrangement of oxygen functional groups, aromatic clusters, linkages between the clusters, and side chains on the clusters. The structural characteristics were used to construct molecular models specific to the coals examined. Also, the structural data were related to their hydroliquefaction yields such as potential product, their distribution and hydrogen consumption. The arrangements of aromatic clusters and functional groups are similar in the three coals. Two to four aromatic clusters of similar size are linked to each other by alkyl C-C bonds, making a chain of aromatic clusters. Two or more of these chains are connected to each other by ester and ether groups. The three coals are different in the distributions of aromatic clusters, oxygen functional groups, and side chains. The lignite and bituminous coal contain fewer large aromatic clusters than the subbituminous coal, although they contain similar amounts of single ring and two-fused ring aromatic clusters. Hydroxyl and either groups comprise more of the oxygen in lignite than the ester and carbonyl groups. However, the ester and carbonyl groups comprise more of the oxygen than hydroxyl and ether groups in the subbituminous coal. Most oxygen of the bituminous coal was in the form of ether and hydroxyl groups. The lignite and subbituminous coal contain more side chains than the bituminous coal. The above structural characteristics were determined by controlled solubilization of each coal, followed by solvent fractionation of the product, and detailed analyses of the product fractions.

28833 (EPRI-AP—5460-SR, pp 2.1-2.17) **Structural studies on a Wyodak subbituminous coal: the potassium - crown ether reaction.** Narayan, R.; Huang, S.L. (Purdue Univ., Lafayette, IN (USA)). Feb 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920202/JAW. (CONF-8705261—).

From 12. annual EPRI contractors' conference on fuel science and conversion; Palo Alto, CA, USA (13 May 1987).

Detailed K-CE reaction studies as a continuation of their efforts on the gentle dismantling of the coal to produce soluble coal oligomers amenable to chemical and spectroscopic analysis, is presented. A modified workup procedure for the K-CE reaction, incorporating a THF extraction step for the alkali solubles, gave total THF solubles of 31%. Further corroborating evidence for polymethylene groups as pendant side chains and linkages joining coal clusters in the coal macromolecule is documented. A possible biogenesis scheme for the formation of polymethylenes is offered. Detailed NMR studies identified carboxyl groups (~ COOH) as a major oxygen functionality along with dioxy aromatic structures. Molecular weight studies of the soluble fractions depicts a coal macromolecule as comprised of coal clusters of polymethylene compounds with molecular weight Mn = 400-600 and Mw = 1400-1980, dioxycarboxy coal oligomers of molecular weight-Mn = 500-1000 & Mw = 1450-3350, and a polar hydrocarbon fraction with Mn = 900-1300 and Mw = 4000 linked by K-CE cleavage linkages.

28834 (EPRI-AP—5460-SR, pp 17.1-17.15) **Effect of coal concentration on product distribution in CANMET coprocessing.** Rahimi, P.M.; Fouda, S.A.; Kelly, J.F. (Canada Centre for Mineral and Energy Technology, Sydney, Nova Scotia). Feb 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920202/JAW. (CONF-8705261—).

From 12. annual EPRI contractors' conference on fuel science and conversion; Palo Alto, CA, USA (13 May 1987).

The effect of feed coal concentration on the characteristics of distillate products was investigated using High Performance Liquid Chromatography and Field Ionization Mass Spectrometry (FIMS). The distillates were obtained by coprocessing Forestburg subbituminous coal and Cold Lake vacuum bottoms from Alberta in a nominal 1 kg/h bench scale unit. Distillates from three different coal concentration experiments at 3.7, 23.9 and 39.5 wt % on a maf slurry feed basis were chosen for this study. Gross distillate (205-525°C) characteristics were determined using elemental analysis and ^1H NMR. The distillates were separated into five different fractions using a Polar Amino Cyano column. Analysis of the fractions indicated that increasing coal concentration from 3.7 wt% to 23.9 wt% results in an increase in the amount of polar materials and a subsequent decrease in the amount of saturated compounds. The weight percent of monoaromatics and polyaromatics were not effected by the amount of coal present in the slurry feed. The number and weight average molecular weights of the distillates boiling between 205-525°C and their hydrocarbon-type fractions decreased as the coal concentration increased. Each hydrocarbon-type fraction was analyzed by ^1H NMR and FIMS to determine the effect of coal concentration on compound-type distribution. The results show that increasing coal concentration has a significant effect on compound-type distribution and, in part, coal may enhance the upgrading of bitumen. Based on preliminary isotopic mass balance measurements which take advantage of the difference between the $^{13}C/^{12}C$ ratio of coal and bitumen, the amount of coal-derived carbon in the coprocessing distillate was estimated.

28835 **Comparison of the behavior of trace elements during acid leaching of ashes from several coals.** Watson, J.S. (Chemical Technology Div., Oak Ridge National Lab., Oak Ridge, TN 37831-6224 (USA)). pp v of Fly ash and coal conversion by-products: Characterization, utilization and disposal III. McCarthy, G.J.; Glasser, F.P.; Roy, D.M.; Diamond, S. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—). Contract AC05-84OR21400.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

The leaching of fly ash from eastern U.S. coals with mineral acid is the initial step in a series of potential processes for producing useful and marketable materials from the ash. This initial leaching step removes most, or all, of the more soluble (generally amorphous) materials from the ash and leaves an inert residue, believed to be mostly mullite and silica. Chemical analyses of the leachate and the residual inert materials indicate the original distribution of the trace elements in the phases. Significant differences in crystallography, composition and leaching behavior have been noted in ash samples from coals from various regions, of various types, and

sometimes even in ash samples from the same or similar coals. Trace element analyses of fly ash leachates provide a useful means of studying coal characteristics and of determining how the trace elements are incorporated in various types of fly ashes.

0108 Waste Management

REFER ALSO TO CITATION(S) 28835

28836 (PB—88-173182/XAB) Road-base construction utilizing coal-waste materials. Research report. Hunsucker, D.; Sharpe, G.W.; Rose, J.G.; Deen, R.C. (Kentucky Transportation Research Program, Lexington (USA)). Jul 1987. 21p. (UKTRP—87-15). NTIS, PC A03/MF A01.

This paper describes the development and implementation of a no-cement concrete mixture containing pulverized fuel ash (PVA) and atmospheric fluidized-bed combustion (AFBC) by-products as the cementitious components for combination with conventional limestone aggregates used as bulk filler. The paper presents a summary of laboratory evaluations and the application of those results to the design of a base for roadway construction. The paper also describes the construction, evaluation, and performance of a pilot application of this material used as a base for a thin bituminous pavement.

28837 Wildlife investigations at a coal refuse reclamation site in southern Illinois. Pentecost, E.D.; Stupka, R.C. (Argonne National Lab., IL (USA)). pp 107-118 of Surface mining and fish/wildlife needs in the eastern United States. Samuel, D.E.; Stauffer, J.R.; Hocutt, C.H.; Mason, W.T. Jr. (eds.). Washington, DC; Government Printing Office (1979). (CONF-781240—).

From Surface mining and fish/wildlife needs in eastern United States; Morgantown, WV, USA (3 Dec 1978).

Wildlife studies of a reclaimed coal refuse pile were conducted during the summer months of 1977 and 1978. During the period of May-September 1977 and May-July 1978 live-trap censuses were made. Small mammal species observed in 1977 included the white-footed mouse, house mouse and meadow vole. In 1978 the prairie vole was also a common resident of the site. Population density estimates for house mice and prairie vole were 20 (+/- 19.4) and 37.5 (+/- 20) respectively in June 1978. Evidence of habitat segregation was observed between meadow vole and prairie vole with the former species occupying densely vegetated areas of tall fescue, birdsfoot trefoil and cereal rye while prairie vole was more abundant in open areas with similar vegetation. Both the mammalian and avian species observed on site were those typical of early old-field communities in Southern Illinois. Four passerine species nested on site during the second year following seeding. No onsite nesting activity occurred during 1977. Common amphibians observed around the pond included the southern leopard frog, Blanchards' cricket frog and american toad. Utilization of the pond by these species occurred the first summer after reclamation was completed.

0109 Environmental Aspects

REFER ALSO TO CITATION(S) 28835

28838 DOE repowering report cites benefits possible from clean coal technologies. *Journal of the Air Pollution Control Association;* **38**: No. 2, 186(Feb 1988).

Refurbishing aging coal-burning power plants with new clean coal technology - a concept known as repowering - could lead to deep, sustained reductions in environmental pollutants while potentially meeting much of the anticipated demand for new power capacity in the US through the year 2010. These are the conclusions of a new report issued by the Department of Energy. Entitled The Role of Repower in America's Power Generation Future, the report analyzes both the environmental benefits and potential increases in nationwide generating capacity that could come from replacing older coal-fired boilers with new fluidized bed or gasification combined cycle power systems. The report also analyzes the cost of controlling emissions through repowering. It concludes that the additional cost of emission control could be only 35 to 60% of the emission removal costs of conventional pollution control devices, such as scrubbers. The report examines three types of repowering technologies: the atmospheric (pressure) fluidized bed combustion system, the pressurized fluidized bed combustion/combined cycle system, and the integrated gasification/combined cycle system. Versions of each of these technological approaches are being developed or demonstrated in either government- or industry-financed programs, and the repowering report states that ongoing and planned demonstration projects will be necessary before the full benefits of repowering can be realized.

28839 Whole tree studies with sulfur-35 tracer. Garten, C.T. Jr. (Oak Ridge National Lab., TN (USA)). pp 787-788 of 194. National Meeting of American Chemical Society, Division of Environmental Chemistry. Washington, DC; American Chemical Society (1987). (CONF-870802—).

From 194. American Chemical Society national meeting; New Orleans, LA, USA (30 Aug 1987).

Due to the proximity of three coal-fired power plants, the deposition of sulfate-S to Walker Branch Watershed, Tennessee, in bulk precipitation is among the highest measured in the US. Prior estimates of annual sulfate-S inputs to the watershed in bulk precipitation range from 11 to 26 kg/ha. In 1986, they conducted experiments on Walker Branch Watershed by labelling two deciduous tree species, yellow poplar (Liriodendron tulipifera) and red maple (Acer rubrum) with radioactive sulfur-35 (87 day half-life). Their objectives were to quantify the mobility of foliar sulfur (traced by sulfur-35) and to describe its leaching physiology, and to determine how these tree species were processing S in an environment where atmospheric deposition of S is far in excess of the forest's nutritional requirements.

0140 Combustion

REFER ALSO TO CITATION(S) 29162

28840 (DOE/PC/70775—11) Synthetic chars for studies of char combustion mechanisms:. (California Inst. of Tech., Pasadena (USA)). 1987. Contract FG22-84PC70775. 8p.

The physical and chemical properties of synthetic char particles formed by atomization of a solution containing a polymer of furfuryl alcohol and pore formers in acetone were examined in detail. The plain polymer char shows only pores smaller than about 20 nm, while that containing carbon blace includes a small volume of pores as large as 0.5 microns. The former was typical of all but the chars containing carbon black or that formed from tannic acid which formed cenospheres. The surface areas of the glassy carbons increased dramatically during combustion. Combustion experiments were undertaken to map the increase of the surface area with burn-off. To examine the source of this large surface area, small angle X-ray scattering (SAXS) was used as a separate measurement of the porous microstructure. 3 figs., 3 tabs.

28841 (DOE/PC/80528—T9) Group combustion of coal particles:. Annamalai, K.; Ramalingam, S.C.; Ryan, W.R. (Texas A and M Univ., College Station (USA). Dept. of Mechanical Engineering). Dec 1987. Contract FG22-85PC80528. 159p. NTIS, PC A08/MF A01; GPO Dep. Order Number DE88004064/JAW.

As opposed to individual particle combustion (IPC) modeling, a group combustion (GC) theory is proposed for the combustion modeling of charcarbon particles. The group behavior for a cloud of particles represents the change in the burning characteristics due to collective behavior of particles with or without a group flame. To gain a basic understanding of the group behavior, a simple model such as the steady state analysis of a spherically symmetric cloud of charcarbon particles burning in quiescent air, was used to obtain results for the cloud burning rate. The most important objective was to relate the results from individual particle combustion (IPC) model to the Group Combustion (GC) model. This second annual report deals with experimental correlation of steady state results, non-steady group ignition and combustion of a cloud of char particles. A computer code based on the non-steady model was developed and using this code, steady state was simulated and the results were compared with the explicit results. The results are presented for cases with frozen gas phase and also for

cases with gas phase CO oxidation reaction along with CO_2 reduction at the char surface. 40 refs.

28842 **(PB—88-157102/XAB) Fate of some trace elements in fluidized-bed combustion and gasification processes.** Mojtahedi, W.; Backman, R.; Larjava, K. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). 1987. 49p. (VTT-PUB—42). NTIS, PC E03/MF A01.

Coal and municipal waste (MSW) contain many trace elements which are released upon combustion and gasification and have toxic forms at certain concentrations. These pollutants must be removed, if increasingly stricter emission standards are to be met. Four metals, namely: cadmium (Cd), lead (Pb), zinc (Zn), and mercury (Hg), were selected for study and multicomponent, multiphase equilibrium calculations were carried out to determine which elements volatilize upon combustion and gasification and which ones condense upon cooling the flue gases. It was also intended to determine the distribution of the trace element species in the product streams. Both fluidized-bed combustion and gasification processes were studied having coal and municipal solid waste as fuel. A temperature range of 200-1300 C and two operating pressures of 1 and 10 bar were employed. Air ratio was varied from 0.3 to 2.0, under both operating pressures. The results show some interesting changes in the composition of the combustion gases with changes in temperature as well as with the air ratio. Cd, Hg, and Pb seem to be totally volatilized at 700-900 C temperature range, but Zn only partially. Upon cooling, sulphates are formed in oxidizing, but sulphides in reducing atmosphere.

28843 **Group combustion of a cylindrical cloud of char/carbon particles.** Annamalai, K.; Ramalingam, S.; Dahdah, T.; Chi, D. (Department of Mechanical Engineering, Texas A & M University, College Station, TX 77843). *Journal of Heat Transfer;* **110**: No. 1, 190-200(Feb 1988).

Extensive experiments were carried out in the past in order to obtain kinetics data on the pyrolysis of coal particles and the char reactions. The literature survey distinctively reveals two kinds of studies: (i) Individual Particle Combustion (IPC) and (ii) Combustion of Particle Streams or Clouds. The experimental data obtained with particle streams are normally interpreted using IPC models with the a priori assumption that the cloud is dilute. But the term "dilute" is rarely quantified and justified considering the collective behavior of a cloud of particles. The group combustion model accounts for the reduction in burning rate due to the collective behavior of a large number of particles. While the spherical group combustion model may be employed for coal/char spray combustion modeling, the cylindrical group combustion model is more useful in interpreting the experimental data obtained with a monosized stream of particles. Hence a cylindrical group combustion model is presented here. As in the case of spherical group combustion models, there exist three modes of combustion: (i) Individual Particle Combustion (IPC), (ii) Group Combustion (GC), and (iii) Sheath Combustion (SC). Within the range of parameters studied, it appears that the cylindrical and spherical cloud combustion models yield similar results on nondimensional cloud burning rates and on the combustion modes of a cloud of particles. The results from group theory are then used to identify the mode of combustion (IPC, GC, or SC) and to interpret the experimental data.

0150 Marketing And Economics

REFER ALSO TO CITATION(S) 29150

0160 Health And Safety

REFER ALSO TO CITATION(S) 28802, 29428, 29532

02 PETROLEUM

0201 Reserves

REFER ALSO TO CITATION(S) 28853, 28854

0202 Geology And Exploration

REFER ALSO TO CITATION(S) 28853, 28854

28844 **(DOE/ER/13748—1) Ammonium silicate diagenesis and its influence on the interpretation of fixed-ammonium anomalies as an exploration tool:.** Williams, L.B.; Ferrell, R.E. Jr. (Louisiana State Univ., Baton Rouge (USA). Basin Research Inst.). 1 Mar 1988. Contract FG05-87ER13748. 4p.

Research was started on the analysis of fixed-NH/sub 4/ content of minerals. Experimental apparatus was set up for the synthesis of NH/sub 4/-clays under varying time, temperature and pH constraints. Results are briefly discussed of the first completed experiments of Na-Montmorillonite and Silver Hill Illite. An increase in fixed NH/sub 4/ content was indicated over time and with higher temperatures. Examination of black shales of varying levels of organic maturity. Three Precambrian samples were analyzed in order to test long-term retention. Ammonium was found fixed in feldspars, Wilcox cores from the Fordoche oil field were also studied. Low concentrations of NH/sub 4/ near oil horizons were indicated, with higher concentrations in the adjacent shales. (CBS)

0203 Drilling And Production

REFER ALSO TO CITATION(S) 29300

28845 (DOE/BC/10844—10, pp 27-57) **Ampholytic copolymers of sodium 2-acrylamido-2-methylpropanesulfonate with 2-acrylamido-2-methylpropane-dimethylammonium chloride: synthesis and characterization.** McCormick, C.L.; Johnson, C.B. Dec 1987. NTIS, PC A10/MF A01. Order Number DE88001207/JAW.

In Polymers for mobility control in enhanced oil recovery: Second annual report, October 1986-September 1987.

Copolymers of 2-acrylamido-2-methylpropanedimethylammonium chloride (AMPDAC) and 2-acrylamido-2-methylpropanesulfonate (NaAMPS) were prepared by free radical polymerization employing potassium persulfate as the initiator. Copolymer compositions were determined from elemental analysis and ^{13}C NMR data. Reactivity ratio studies yielded r_1 and r_2 values of 0.22 and 0.31 for the AMPDAC (M_1) and NaAMPS (M_2) monomer pair. Molecular weights, determined using low-angle laser light scattering, were found to decrease with AMPDAC content, and ranged from 1.6-9.5 x 10^6 g/mole. Copolymer microstructures were predicted by calculation of reactivity ratios. 27 references, 4 figures, 10 tables.

28846 (DOE/BC/10844—10, pp 58-86) **Ampholytic copolymers of sodium 2-acrylamido-2-methylpropanesulfonate with 2-acrylamido-2-methylpropane-dimethylammonium chloride: solution properties.** McCormick, C.L.; Johnson, C.B. Dec 1987. NTIS, PC A10/MF A01. Order Number DE88001207/JAW.

In Polymers for mobility control in enhanced oil recovery: Second annual report, October 1986-September 1987.

Dilute solution properties of copolymers of 2-acrylamideo-2-methylpropanedimethylammonium chloride (AMPDAC) with 2-acryl-amido-2-methylpropanesulfonate (NaAMPS) have been studied as a function of composition, temperature, time, pH, and added

electrolytes. Phase separation and potentiometric studies have also been performed. The AMPDAC-NaAMPS copolymers decrease in molecular weight with increasing AMPDAC content. Typical polyelectrolyte behavior was observed for copolymers containing small amounts of either monomer. However, copolymers containing nearly equimolar amounts of the two monomers displayed a minimum in viscosity in pure water and a maximum in viscosity in concentrated salt solutions. The viscosity behavior as a function of composition was found to parallel microstructural features of the copolymers. 12 references, 15 figures, 3 tables.

28847 (DOE/BC/10844—10, pp 87-123) **Synthesis and aqueous solution behavior of associative acrylamide/N-alkylacrylamide copolymers.** McCormick, C.L.; Nonaka, T.; Johnson, C.B. Dec 1987. NTIS, PC A10/MF A01. Order Number DE88001207/JAW.

In Polymers for mobility control in enhanced oil recovery: Second annual report, October 1986-September 1987.

Copolymers of acrylamide (AM) and N-alkylacrylamides have been prepared by micellar copolymerization in aqueous solution utilizing sodium dodecylsulfate as a surfactant and potassium persulfate as the initiator. Synthesis, characterization, and copolymerization of the N-alkylacrylamide monomers with eight, ten, and twelve carbons on the alkyl substituent are described. Rheological properties have been studied as a function of polymer concentration, electrolyte concentration, temperature, and shear rate. A remarkable increase in apparent viscosity observed at low mole fractions of the N-alkylacrylamide in the copolymer occurs at a critical concentration which is a function of length of the alkyl chain in the monomer and copolymer molecular weight. Viscosity behavior is interpreted in terms of a concentration dependent model involving interchain hydrophobic associations in aqueous solutions. 32 references, 22 figures, 3 tables.

28848 (DOE/BC/10844—10, pp 124-150) **Pyrene fluorescence as a reporter of the rheological behavior of structurally tailored macromolecules.** McCormick, C.L.; Hoyle, C.E.; Clark, M.D.; Lundy, C.E. Dec 1987. NTIS, PC A10/MF A01. Order Number DE88001207/JAW.

In Polymers for mobility control in enhanced oil recovery: Second annual report, October 1986-September 1987.

Selected copolymers of acrylamide (AM) with sodium-3-acrylamido-3-methylbutanoate (NaAMB), diacetone acrylamide (DAAM), n-propyldiacetone acrylamide (PDAAM) and n-decylacrylamide (C_{10}) have been studied in aqueous solution utilizing pyrene as a fluorescence probe. The magnitude of the pyrene fluorescence lifetimes, fluorescence quantum yields, and quenching rate constants with added sodium bromide have been used to probe structural organization. The fluorescence studies along with rheological measurements indicate the following: NaAMB/AM polyelectrolytes show expected behavior with chain extension and hydration a function of pH and electrolyte strength; DAAM/AM and C_{10}/AM copolymers exhibit cooperative interchain associations; the PDAAM copolymers form independent micelles with surfactant characteristics. In addition, the C_{10}/AM copolymer with 0.75 mol % n-decylacrylamide shows a concentration dependent association in water. A model of solution domain formation has been developed consistent with rheological behavior of the C_{10}/AM copolymer. 25 references, 13 figures, 2 tables.

28849 (DOE/BC/10844—10, pp 151-168) **Size characterization of EOR polymers in solution.** Hester, R.D. Dec 1987. NTIS, PC A10/MF A01. Order Number DE88001207/JAW.

In Polymers for mobility control in enhanced oil recovery: Second annual report, October 1986-September 1987.

EOR polymers must have large hydrodynamic diameters and/or large molecular weights if they are successful in flooding. Several techniques used to measure molecular weights of very large water soluble polymers are reviewed with respect to their inherent problems, advantages, and future potential. The techniques are: solution viscometry, size exclusion chromatography, and dynamic light scattering. There are inherent theoretical and experimental problems associated with all the available methods for size characterization of EOR polymers. Of the methods discussed in this paper, dynamic light scattering appears to have the greatest potential for characterization of an average molecular size. Theoretically, the method is applicable to any polymer-solvent combination and is not bounded by a upper polymer size limit. DLS measurements of diffusion coefficients can be combined with intrinsic viscosity measurements to obtain a molecular weight using the Mandel Kern-Flory relationship. Currently DLS is used primarily to obtain an average size for polydispersed polymers. However DLS has the potential to extract information about the distribution of macromolecular sizes in a EOR polymer. This information will allow an understanding of the effects that EOR polymer size distributions and macromolecular compositions have on polymer solution properties. 23 references.

28850 (DOE/BC/10844—10, pp 169-184) **Determination of molecular weight distributions of large water-soluble macromolecules using dynamic light scattering.** Mettille, M.J.; Hester, R.D. Dec 1987. NTIS, PC A10/MF A01. Order Number DE88001207/JAW.

In Polymers for mobility control in enhanced oil recovery: Second annual report, October 1986-September 1987.

The use of dynamic light scattering (DLS) for the determination of molecular weight distributions of water-soluble macromolecules was investigated. DLS data was obtained for a dextran polymer. Subsequent data analysis for molecular weight distribution determination was performed using a nonlinear least squares technique. The distribution function that was assumed during the analysis was the generalized exponential function. The calculated molecular weights are in fair agreement with the expected results. 24 references.

28851 (DOE/BC/10844—10, pp 185-198) **Molecular weight distributions of ultra high molecular weight water-soluble polymers using size-exclusion chromatography.** Dearman, D.; Hester, R.D. Dec 1987. NTIS, PC A10/MF A01. Order Number DE88001207/JAW.

In Polymers for mobility control in enhanced oil recovery: Second annual report, October 1986-September 1987.

Size exclusion chromatography (SEC) analysis is being developed to determine molecular weight distributions of large water soluble polymers. A low-flow SEC system was designed and built specifically to deal with large water-soluble EOR polymers. Column packing materials are being tested for efficiency and accuracy using Dextran standards of known molecular weights. The molecular weight distributions generated using SEC are comparable to those obtained using laser light scattering. 11 references.

28852 (DOE/BC/10844—10, pp 199-211) **Dispersion correction for size exclusion chromatography of macromolecules.** Hester, R.D. Dec 1987. NTIS, PC A10/MF A01. Order Number DE88001207/JAW.

In Polymers for mobility control in enhanced oil recovery: Second annual report, October 1986-September 1987.

Efforts to improve size exclusion chromatography (SEC) analysis are reported utilizing methods which correct for dispersion or chromatogram broadening. Dispersion, sometimes referred to as band broadening or zone spreading, can cause large errors in SEC attempts to measure hydrodynamic volume and molecular weight distribution of macromolecules in solution. These effects are especially large for SEC separation of ultrahigh molecular weight polymers such as those used in enhanced oil recovery. This is due to the long analysis times required. Tung has mathematically described SEC dispersion as resulting from the convolution of a true chromatogram with a spreading function. This convolution produces and observed chromatogram which is broader than the true chromatogram. An algorithm has been developed for solving Tung's dispersion equation for the true (non-dispersed) chromatogram. Computer techniques and refined data analysis methods have been developed to aid in this endeavor. Dispersion corrected chromatograms can be generated which thereafter can be used to determine a molecular size of molecular weight distribution function. The improved SEC data analysis system is being used to measure macromolecular hydrodynamic size distributions of EOR candidate polymers synthesized in their laboratories. 10 references, 3 figures, 3 tables.

28853 (DOE/FE/60600—T17-App.2) Western Shallow Oil Zone, Elk Hills Field, Kern County, California:. Carey, K.B. (Evans, Carey and Crozier, Bakersfield, CA (USA)). 1 Sep 1987. Contract AC01-85FE60600. 581p.

The general Reservoir Study of the Western Shallow Oil Zone was prepared by Evans, Carey and Crozier as Task Assignment 009 with the United States Department of Energy. This study, Appendix II addresses the first Wilhelm Sands and its sub unites and pools. Basic pressure, production and assorted technical data were provided by the US Department of Energy staff at Elk Hills. These data were accepted as furnished with no attempt being made by Evans, Carey and Crozier for independent verification. This study has identified the petrophysical properties and the past productive performance of the reservoir. Primary reserves have been determined and general means of enhancing future recovery have been suggested. It is hoped that this volume can now additionally serve as a take off point for exploitation engineers to develop specific programs toward the end.

28854 (DOE/FE/60600—T17-App.5) Western Shallow Oil Zone, Elk Hills Field, Kern County, California:. Carey, K.B. (Evans, Carey and Crozier, Bakersfield, CA (USA)). 1 Sep 1987. Contract AC01-85FE60600. 520p.

This study, Appendix V, addresses the Gusher Sands and their sub units and pools. Basic pressure, production and assorted technical dta were provided by the US Department of Energy staff at Elk Hills. These data were accepted as furnished with no attempt made by Evans, Carey and Crozier for independent verification. This study has identified the petrophysical properties and the past productive performance of the reservoir. Primary reserves have been determined and general means of enhancing future recovery have been suggested. It is hoped that this volume can now additionally serve as a take off points for exploitation engineers to develop specific programs towards these ends. 16 refs., 9 tabs.

0204 Processing

REFER ALSO TO CITATION(S) 28814, 28815, 28816, 29316, 29319, 29321, 29322

28855 Selective oxidative dehydrogenation of propane over V-Mg-O catalysts. Chaar, M.A.; Patel, D.; Kung, H.H. (Northwestern Univ., Evanston, IL (USA)). *Journal of Catalysis;* **109**: No. 2, 463-467(Feb 1988).

Vanadium-magnesium oxides were found to be active and selective catalysts for the oxidative dehydrogenation of propane to propene. A selectivity of up to 65% was obtained at 10% conversion, but decreased with increasing conversion. No oxygenates were detected. The reaction rate was 0.6 +/- 0.15 order in propane and zeroth order in oxygen. For comparison, the rate for butane oxidative dehydrogenation was 0.85 +/- 0.15 in butane and zeroth order in oxygen. Both reactions were believed to proceed primarily with the breaking of a methylene C-H bond to form an adsorbed alkyl radical species.

28856 Displacement of cyclohexane by water on a ruthenium surface. Polta, J.A.; Flynn, D.K.; Thiel, P.A. (Iowa State Univ., Ames (USA)). *Journal of Catalysis;* **99**: No. 1, 88-94(May 1986). Contract W-7405-ENG-82.

Water can displace cyclohexane from chemisorption sites on a Ru(001) surface. In so doing, thermal desorption spectroscopy indicates that the water forms three-dimensional, hydrogen-bonded clusters which are two layers deep, much as it would on the clean surface. Water forces the cyclohexane into weakly bound states. This is apparently driven by a combination of effects: first, a single water molecule is more strongly bound to the ruthenium surface than a cyclohexane molecule, and second, the packing density of water in the hydrogen-bonded bilayer is much greater than the packing density of the chemisorbed cyclohexane. Taking both effects into consideration, replacement of a chemisorbed cyclohexane layer with a water bilayer is energetically favored by 56 to 8 kcal per mole of surface metal atoms. The data also show that the preferential chemisorption of water on ruthenium is not limited by the kinetics of diffusion or displacement in these experiments, but rather reflects a true equilibrium state. 18 references.

28857 Rh/SiO_2: catalyst characterization and study of the hydrogenolysis of methylcyclopropane. Karpinski, Z.; Chuang, T.K.; Katsuzawa, H.; Butt, J.B.; Burwell, R.L. Jr.; Cohen, J.B. (Northwestern Univ., Evanston, IL (USA)). *Journal of Catalysis;* **99**: No. 1, 184-197(May 1986). Contract AC02-77ER04254.

The adsorption of hydrogen, carbon monoxide, and oxygen and X-ray line profile analysis have been investigated on a series of Rh/SiO_2 catalysts made by ion exchange with $Rh(NH_3)_5(H_2O)^{3+}$ and by impregnation with $Rh_4(CO)_{12}$ and $Rh_6(CO)_{16}$. The percentage exposed (D) of the series of catalysts as measured by hydrogen chemisorption at 25°C varied from 11 to 108%. Ease of reduction of the oxidized catalysts decreased as D increased and reduction in hydrogen was incomplete in hydrogen at 25°C except for the catalysts of smallest D. The rates of hydrogenolysis of methylcyclopropane (MCP) at 0°C decreased with increasing D by a factor of about 9 over the range of D of the series of catalysts for catalysts pretreated O_2, 300°, 0.5; H_2, 300°, 1; He, 450°, 1 where the last number in triad was the time of exposure in hours. Omission of He, 450, 1 led to decreased rates and augmented structure sensitivity, but H_2, 25°, 1 without He,450° 1 led to inverted structure sensitivity, presumably because of residual oxygen on rhodium. The activation energy for hydrogenolysis was about 37 kJ/mol. The ratio of isobutane to butane in the products was about 20 for D = 11%, declined rapidly with increasing D, and became about 3.5 for D > 50%. Pretreatment conditions (temperature of pretreatment by H_2, presence or not of terminal He, 450°, l) had little effect on the ratio. 47 references.

28858 Ethane hydrogenolysis catalyzed by W(100). Wax, M.J.; Kelley, R.D.; Madey, T.E. (National Bureau of Standards, Gaithersburg, MD (USA)). *Journal of Catalysis;* **98**: No. 2, 487-490(Apr 1986).

The ability of the (100) face of tungsten to catalyze ethane hydrogenolysis has been investigated. At 573 K, methane is formed with a specific activity of 0.01 molecules per surface tungsten atom per second (100 Torr H_2, 1 Torr C_2H_6), with no evidence of catalyst deactivation even after several hundred turnovers. Hydrogenolysis is approximately first-order in ethane and half-order in dihydrogen, and displays an apparent activation energy of 27 kcal/mol. Negligible activity is displayed by clean tungsten; the true catalyst appears to be a monolayer of carbide which is formed on the surface of the tungsten on exposure to the reactants. 11 references.

28859 Role of the zeolite in the hydrogenolysis of C_2 and C_3 hydrocarbons on RuNaY catalysts. Sajkowski, D.J.; Lee, J.Y.; Schwank, J.; Tian, Y.; Goodwin, J.G. Jr. (Univ. of Michigan, Ann Arbor (USA)). *Journal of Catalysis;* **97**: No. 2, 549-560(Feb 1986). Contract FG22-83PC60805.

The catalytic properties for the hydrogenolysis of ethane, propane, and cyclopropane of a series of highly dispersed RuNaY catalysts have been investigated. These catalysts have activities and selectivities for ethane and propane hydrogenolysis similar to other supported ruthenium catalysts. However, the activity of the RuNaY for cyclopropane hydrogenolysis is much higher than that of Ru on conventional oxide supports, while the selectivities remain in a range expected for well-dispersed ruthenium. The increase in activity for the RuNaY catalysts is due mainly to the presence of highly dispersed Ru particles made possible by the zeolite support. A destabilization of the cyclopropane ring by the electrostatic field of the zeolite, however, does not seem to contribute significantly to the observed rate increase. It appears that the ring opening of cyclopropane and the hydrogenolysis of cyclopropane to ethane and methane have a common intermediate, the formation of which is rate determining for both reactions. The discovery that on Ru the ring opening of cyclopropane is structure sensitive is surprising since this reaction is generally considered as a classic example for structure insensitivity. 34 references.

0205 Products And By-products

REFER ALSO TO CITATION(S) 29318

28860 **(AD-A—187776/0/XAB) Standardization of lubricity test. Interim report, November 1985-November 1986.** Biddle, T.B.; Meehan, R.J.; Warner, P.A. (Pratt and Whitney Aircraft, West Palm Beach, FL (USA). Government Products Div.). Aug 1987. 37p. (PW/GPD-FR—19031-1). NTIS, PC A03/MF A01.

Since the early 1960s the Ball-on-Cylinder Lubricity Evaluator (BOCLE) test has been recognized as the best available method for providing a relative system of measurement of the lubricity properties of jet engine fuels. The technical effort described in this report was directed at refining and standardizing the (BOCLE) test. It focused on identifying variables suspected of affecting the test method precision. The Falex Ring was shown to significantly enhance BOCLE-test precision and eliminate many of the problems associated with the conventional AMS 6444 test cylinder. Test results showed that the source of the test ball can have a significant effect on BOCLE test results. SKF Swedish precision balls were found to provide optimum batch to batch consistency. Isopar M + 30 ppm DuPont DCI-4A was shown to be a reproducible fluid suitable for use as a standard reference fluid for BOCLE testing.

0207 Marketing And Economics

REFER ALSO TO CITATION(S) 29137

0209 Environmental Aspects

REFER ALSO TO CITATION(S) 29437, 29438

0230 Properties

28861 (EPRI-AP—5460-SR, pp 13.1-13.33) **Assessment of rapid methods for predicting stability and compatibility of residual fuel oils.** Anderson, R.P.; Goetzinger, J.W.; Reynolds, J.W. (National Institute for Petroleum and Energy Research, Bartlesville, OK (USA)). Feb 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920202/JAW. (CONF-8705261—).

From 12. annual EPRI contractors' conference on fuel science and conversion; Palo Alto, CA, USA (13 May 1987).

In recent years there has been a significant decrease in the quality of residual fuel oils available to the electric utility industry. Conventional fuel oil analyses and specifications are inadequate to predict or prevent handling problems due to instability or incompatibility. The objective of this project is to develop and evaluate rapid practical tests which utilities can use as an aid in preventing problems resulting from fuel instability and incompatibility. In an earlier Phase I of this project, utility-supplied problem and non-problem fuel oils were analyzed in an effort to understand the reasons for reported problems. Baseline tests for determining instability and incompatibility characteristics were developed. The just-completed Phase IIA of the project has dealt with the development and evaluation of these potential predictive methods using supplemental residual fuels supplied by utilities and refineries. The results of this second phase of the program have provided the basis for recommendations for implementation of predictive testing at selected utilities. Sediment by hot filtration, the Shell accelerated dry sludge test, sediment by extraction (coke), and a modified spot test have been shown to correlate with stability characteristics of residual fuels. The Exxon compatibility prediction based on solubility parameters for the solvent and asphaltene fractions of the fuel is also promising for field application. A very simple compatibility test based on only two parameters, gravity and modified spot test, shows promise but needs further evaluation.

0250 Combustion

28862 (EPRI-AP—5247, pp 3.3-3.29) **Review of relationships between fuel oil properties and particulate emissions.** Dryer, F.L. (Princeton Univ., NJ (USA)). Jun 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920473/JAW. (CONF-8610288—).

From 2. fuel oil utilization workshop; Philadelphia, PA, USA (7 Oct 1986).

Properties for existing and future heavy fuel liquids are both natural-source and process-dependent, and the variability of heavy fuel properties will likely continue to worsen. The complexity of any particular analytical characterization which would be appropriate for judging the acceptability of a particular fuel for use in a particular combustion system or the engineering modifications required to achieve acceptable particulate emissions suggests that a return to more empirical fuel characterization techniques offers a simpler approach. Recent fundamental and supporting combustion system studies suggest that the coke formation process is directly related to fuel properties alone, while the burnout process is affected by both fuel properties and combustion system parameters. Existing empirical tests do not lend themselves to the characterization of coke formation and burnout properties independently, and therefore are not capable of predicting fuel variability effects on particulate emissions consistently. Empirical techniques which determine coke formation from heavy fuel samples using temperature-time conditions similar to those experienced in combustion systems eliminate the possible effects of disparate heating rates on coke yield and properties. Techniques which yield actual cenospheric coke particles under controlled conditions would produce particles which could be used to independently determine fuel property effects on coke particle burnout rate.

28863 (EPRI-AP—5247, pp 3.31-3.44) **Prediction and control of combustion emissions from oil-fired boilers (current status).** Mormile, D.J.; Hersh, S.; Kerho, S.; Giovanni, D.V. (Consolidated Edison Company of NY, Inc., New York (USA)). Jun 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920473/JAW. (CONF-8610288—).

From 2. fuel oil utilization workshop; Philadelphia, PA, USA (7 Oct 1986).

The current status of a program to quantify the impacts of fuel oil changes on boiler combustion characteristics and carbonaceous particulate matter emissions will be presented. Specific program objectives are to support purchasing decisions and to extend the range of fuel oils which can be burned within applicable environmental and operational constraints. To support these objectives, a new procedure for assessing the carbon forming tendencies of fuel oils is being developed. This procedure will yield a parameter termed the Coke Formation Index (CFI) which quantifies the mass of coke which will form in a boiler furnace per unit of fuel. This global, fuel-effects parameter provides input into a semi-empirical model of carbon burn-out and particle mass emissions. Combustion hardware to improve carbon burn-out and therefore extend the range of fuels which can be burned within a specific boiler is a major area of investigation for this program.

28864 (EPRI-AP—5247, pp 3.77-3.113) **Particulate emissions from residual oil combustion in boilers.** Walsh, P.M.; Olen, K.R.; Yu, T.U.; Sayre, A.N.; Farmayan, W.F.; Beer, J.M. (Massachusetts Institute of Technology, Cambridge (USA)). Jun 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920473/JAW. (CONF-8610288—).

From 2. fuel oil utilization workshop; Philadelphia, PA, USA (7 Oct 1986).

This paper discusses the reduction in stack emissions by varying the quality of the fuel oil being burned in the boiler. It shows the correlation between the coking property of low-grade fuel oil with the particulate bonding with sulfur. It then goes on to provide a rational basis for the adjustment of operating conditions so that one may fine the widest range of fuels while maintaining stack particulate consistently in compliance with applicable regulations.

28865 (EPRI-AP—5247, pp 3.114-3.134) **Experience of firing an emulsified fuel.** Keith, E.M.; Martel, G.A. Jun 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920473/JAW. (CONF-8610288—).

From 2. fuel oil utilization workshop; Philadelphia, PA, USA (7 Oct 1986).

Northeast Utilities is a medium size investor owned electric utility (4300 MW peak demand) which services much of Connecticut and Western Massachusetts. Generation is a mix of nuclear, hydro, pump storage hydro and six fossil generating stations. Five of the six stations burn residual fuel oil with most of the units being of a base load, coal fired design that are now utilized in cycling service. As a result of changing oil quality and resulting increases in emission, Northeast Utilities in conjunction with Fuel Tech. Inc. conducted a test program to demonstrate the effects of firing a water emulsified fuel. Tests were conducted on Northeast Utilities' Devon Station Unit 6. Unit 6 is a C-E back fired 72 MW boiler which was designed for coal firing and built in 1951. In 1969 the unit was converted to oil firing. The unit fires a 1.0% sulfur residual fuel oil and could not achieve simultaneous NO/sub x/ and particulate emissions compliance. The residual fuel was emulsified with small quantities of water just prior to firing. Results of the test are provided.

28866 (EPRI-AP—5247, pp 3.135-3.165) **Field test of a processed and emulsified residual oil.** Molino, N.M.; Dustako, G.C. (New England Power Service, Westborough, MA (USA)). Jun 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920473/JAW. (CONF-8610288—).

From 2. fuel oil utilization workshop; Philadelphia, PA, USA (7 Oct 1986).

In the past, the foreign and domestic fuel oil used was in conformance with New England Power (NEP) viscosity, sodium and vanadium specifications and, even though the unburned carbon usually exceeded 50% of the total ash, the particulate emissions did not exceed the allowable limit of 0.12 lbs/MBTU. Until recently, the normal process of transferring and mixing several incoming cargoes from storage tanks to a service tank at the tank farm has been enough to mitigate the affect of burning high asphaltene oil shipments. Now, because of its favorable pricing, a steady flow of high asphaltene oil has negated the benefits of blending, thus creating an untenable situation. To avoid a long outage for complete changeout of burners and major modifications to both boiler and burner management systems otherwise required to solve this problem, NEP opted for a short term solution; one that involved trying to improve the quality of atomization by emulsification of the oil and, if necessary, the addition of a combustion catalyst to further accelerate the combustion process. This paper describes a full scale demonstration which involved the preparation and firing of a 450MW boiler with an emulsified high asphaltene oil. Approximately 150,000 barrels of oils were consumed in three tests, each consisting of three runs. In the first test, untreated (neat) oil was burned for three days and emission tests were performed for a base line reference. In the second, conditioned (de-agglomerated) oil was burned and tested for the same period. Finally, a similar burn and test were conducted with conditioned and emulsified oil.

28867 (EPRI-AP—5247, pp 3.167-3.199) **Controlling the effects of deteriorating fuel oil quality through use of an oil-water emulsion.** LaLena, P.P.; Driscoll, T.J.; Moy, W.W. Jun 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920473/JAW. (CONF-8610288—).

From 2. fuel oil utilization workshop; Philadelphia, PA, USA (7 Oct 1986).

Deteriorating fuel oil quality is a contributing factor to excessive particulate emission, high stack opacity, increased furnace and gas path maintenance, and poor combustion efficiency. Past experience indicates that a lessening in the disagreeable effects caused by burning these fuels can be achieved by the addition of: (1) combustion catalysts to the fuel oil stream; (2) highly reactive magnesium oxide to the oil stream; (3) highly reactive magnesium hydroxide to the oil stream; and (4) a fuel oil-water emulsion to yield improved atomization. In the past, each separate component of the treatment program offered promise of improvement but when tested, a dramatic change was not achievable. On the other hand the combination of all three influencing factors in one package might offer an improvement that would justify continued use of the treatment. Both the initial and final phase of the project have been completed showing a marked reduction in particulate emissions and rate of opacity increase.

28868 (EPRI-AP—5247, pp 3.201-3.223) **Large-scale combustion experience with emulsified petroleum fuel.** Olen, K.R.; Woodworth, L.M.; Allen, J.W. (Florida Power & Light Co., Juno Beach (USA)). Jun 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920473/JAW. (CONF-8610288—).

From 2. fuel oil utilization workshop; Philadelphia, PA, USA (7 Oct 1986).

The results of large-scale (200 million Btu/hr) single burner combustion tests carried out on an emulsion of 70% pyrolysis pitch in water, including handling and storage experiences, are presented and discussed. The emulsion, which represents a new form of residual fuel referred to as Emulsified Petroleum Fuel (EPF), demonstrated unique combustion characteristics in earlier smaller-scale tests. Despite higher than expected unburnt carbon particulate levels, the encouraging results from the large-scale tests have provided sufficient confidence to consider a full-scale demonstration of EPF in a utility boiler. Potential application of high-sulfur EPF as a gasifier feedstock is discussed briefly.

28869 (EPRI-AP—5247, pp 3.225-3.263) **Stability and compatibility of residual fuel oils.** Anderson, R.P. (National Institute for Petroleum and Energy Research, Bartlesville, OK (USA)). Jun 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920473/JAW. (CONF-8610288—).

From 2. fuel oil utilization workshop; Philadelphia, PA, USA (7 Oct 1986).

In recent years there has been a marked decrease in the quality of residual fuel oils available to the electric utility industry. Experience has shown that conventional fuel oil analyses are inadequate to allow utilities to prevent or predict handling difficulties due to instability or incompatibility of these lower quality fuels. A number of utility-supplied problem and nonproblem fuel oils have been analyzed in an attempt to understand the reasons for the reported problems. In addition to chemical and physical characterization, these and additional fuels and blends were subjected to baseline tests for determining instability and incompatibility. The baseline test for stability involves long-term aging at 80°C while changes in sediment, viscosity, and asphaltene content are monitored. The baseline test for incompatibility involves actual blend preparation followed by determination of sediment by hot filtration. These baseline tests have been used as a basis for initial evaluation of rapid tests which might be used for the prediction of potential handling problems. Rapid measurements which can be used in prediction of instability or incompatibility problems and are currently undergoing further evaluation include determination of sediment by hot filtration, sediment formation after addition of a poor solvent, determination of coke-like material, measurement of solvent quality and measurement of solvent quality requirement.

28870 (EPRI-AP—5247, pp 3.265-3.280) **Temperature interferences in stability and compatibility testing of residual fuel oils.** Decker, C. (Oiltest, Inc., Roselle Park, NJ (USA)). Jun 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920473/JAW. (CONF-8610288—).

From 2. fuel oil utilization workshop; Philadelphia, PA, USA (7 Oct 1986).

The stability and compatibility (SC) of residual fuel oil blends is a major concern of utilities that maintain oil-fired generating capacity. Instable and incompatible fuels precipitate sludges that interfere with the transport, storage, and efficient conversion of the affected fuel. Unscheduled down-time of generating capacity has been experienced as a direct result of SC problems. One class is the Spot Tests which use chromatographic paper to separate the fuel and sludge qualitatively. The second class consists of the Sediment by Hot Filtration (SHF) tests quantitative methods which use heat, vacuum, and solvent to precipitate, and a filter to separate, the

sludge component of the sample. Pour point interferences occur frequently for both types of analysis when high pour material is tested and the experimental apparatus is improperly designed, installed, or run. These interferences occur due to improper preheating of sample and temperature distribution problems in the apparatus. Data are presented showing the effects of high pour point on the accuracy of test results for both Spot and SHF methods when improper sample preheating and apparatus temperature distribution occur.

28871 (EPRI-AP—5247, pp 3.281-3.305) **EPRI 1986 fuel oil utilization workshop Con Edison's quantity/quality assurance program.** Lodrigueza, R.A. Jr. (Consolidated Edison of New York, NY (USA)). Jun 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920473/JAW. (CONF-8610288—).

From 2. fuel oil utilization workshop; Philadelphia, PA, USA (7 Oct 1986).

This paper summarizes the steps used by Con Edison to maintain quality control on the fuel oils it uses at its utility plants in New York City. Because of the strict air quality regulations in these populated areas, strict adherence to the fuel oil quality must be maintained. This paper discusses the operation of their quality control plan from the delivery to the combustion. It talks about the economics and administrative aspects of the program, including training of the inspectors. It then discusses how the tests are run using average sulfur content, pour point, specific gravity, flash point, viscosity, and sediment and water.

28872 (EPRI-AP—5247, pp 3.307-3.328) **Residual fuel oil R & D in Mexico.** Garcia, A.P. (Instituto de Investigaciones Electricas, Cuernavaca (Mexico)). Jun 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920473/JAW. (CONF-8610288—).

From 2. fuel oil utilization workshop; Philadelphia, PA, USA (7 Oct 1986).

About two thirds of Mexico's electrical generation relies on heavy fuel oils as the primary energy resource, so it is readily understable that IIE's (Instituto de Investigaciones Electricas) fossil fuels R & D program includes a series of project works aimed at solving problems related to the use of heavy fuel oils in steam generators. This paper presents a brief description of some of the work done so far. Results are shown on fuel oil properties, burner aerodynamics, flame properties determination, high and low temperature materials behaviour and MgO additive performance evaluation.

28873 (EPRI-AP—5247, pp 3.329-3.353) **Recent experience with heavy oil firing in the CEGB.** Lawn, C.J. Jun 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920473/JAW. (CONF-8610288—).

From 2. fuel oil utilization workshop; Philadelphia, PA, USA (7 Oct 1986).

The UK Central Electricity Generating Board operates seventeen oil-fired boilers with capacities of either 500 or 660 MW. Apart from a period during the Mineworkers' strike in 1984/1985, these boilers have recently operated on very low load factors. However, much of the research work undertaken in the 1970s has now been applied and tested, and this experience may well be of interest to US utilities. This paper will therefore briefly survey five particular pieces of research, starting with the laboratory work and theoretical analysis, and then indicating how it has been applied to operating plant. These include: the effect of ash composition on carbon burnout; air-fuel mixtures; atomization improvements; improvement in flame monitoring; and overcoming furnace fouling problems. Most of the applications have been concentrated on one particular Station at Fawley, which has four 500 MW boilers built by John Thompson Limited. These were in fact the first purpose-built oil-fired boilers of this capacity in Europe. They are equipped with 32 Hamworthy burners of the pressure jet design.

28874 (EPRI-AP—5247, pp 3.355) **Residual fuel oil users' guidebook.** Schreiber, H. Jun 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920473/JAW. (CONF-8610288—).

From 2. fuel oil utilization workshop; Philadelphia, PA, USA (7 Oct 1986).

In response to an increasing degree of difficulty encountered in firing residual fuel oil with acceptable performance and emission levels in utility power generation equipment, EPRI has undertaken a project to prepare a Residual Fuel Oil Users' Guidebook. This guidebook will provide a comprehensive presentation of currently available information relating to residual oil use. It will be in a looseleaf, easily updatable format, and will consist of four volumes addressing respectively: (1) generally applicable residual oil information, including a bibliography, a glossary, and information related to production, properties, storage, and handling; (2) use of residual oils in utility boilers; (3) use of residual oils in utility gas turbines; and (4) use of residual oils in utility diesels. The information in the guidebook will be gathered from residual oil producers, from utilities using residual oil, and from vendors of equipment, additives, and services related to residual oil use in utility power generation. The guidebook will be organized for easy use as a reference by operations, maintenance, engineering, and procurement personnel in utility companies.

28875 (EPRI-AP—5247, pp 3.385-3.400) **Residual fuel oil quality criteria for electric utility boiler systems.** McHale, C.E.; Marshall, J.J.; Wombles, R.H.; Hersh, S. (Riley Stoker Corp., Worcester, MA (USA)). Jun 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920473/JAW. (CONF-8610288—).

From 2. fuel oil utilization workshop; Philadelphia, PA, USA (7 Oct 1986).

The replacement of lighter crudes with heavier crudes in refinery runs, along with changes in the refinery processing of these feedstocks, translate into decreased quality and increased variability of the residual boiler fuels available to utilities. The relationship between the properties of these low grade fuels and their impact on utilization are not well defined. In addition, residual oil property test methods are not standardized within the industry. Many fuel characterization methods are borrowed from other applications. Therefore, these tests may be inadequate for the utility industry needs. EPRI has initiated a program to improve the quality criteria and property test methods applied to residual fuel oils. The overall project objectives are: understanding the impact of fuel oil properties on utility boiler systems; identifying criterial residual fuel properties; and developing and recommending improved residual fuel property test methods. In support of these major objectives, several subordinate goals have been targeted. These include the establishment of trends in fuel properties from the past, predictions of future fuel quality trends, and developing parametric correlations between various fuel properties to promote understanding and prediction of their impact on oil-fired utility systems.

03 NATURAL GAS

0303 Drilling, Production, And Processing

28876 (PB—88-173083/XAB) **Characterization of produced waters from natural-gas-production operations. Volume 1. Topical report, July 1986-December 1987.** Wesolowski, D.; Broughton, A.; Hansotte, C.A.; Koraido, S.M.; Fillo, J.P. (ERT, Pittsburgh, PA (USA)). Dec 1987. 275p. NTIS, PC A12/MF A01.

See also Volume 2, PB—88-173091.

This report presents the results of a nationwide characterization program for produced waters from non-associated natural-gas production operations. The impetus for the program was the sparsity of existing comprehensive data publicly available on the characteristics and management practices for these production waters. In all, 17 produced water samples from 16 different sites were collected and analyzed. The analytical methods used and parameters tested in the program paralleled those used in EPA's E&P Waste Study and the API's Production Waste Study.

28877 **(PB—88-173091/XAB) Characterization of produced waters from natural-gas-production operations. Volume 2. Appendix E. Analytical data report. Topical report, July 1986-December 1987.** Keith, L.H.; Mertens, S.K.; Shore, F.L.; Shepherd, M.C.; Schrynemeeckers, P.J. (ERT, Pittsburgh, PA (USA)). Dec 1987. 164p. NTIS, PC A08/MF A01.

Also pub. as Radian Corp., Austin, TX. rept No. DCN-87-266-034-05. See also Volume 1, PB—88-173083.

This report presents the results of a nationwide characterization program for produced waters from non-associated natural-gas-production operations. The impetus for the program was the sparsity of existing comprehensive data publicly available on the characteristics and management practices for these production waters. In all, 17 produced water samples from 16 different sites were collected and analyzed. The analytical methods used and parameters tested in the program paralleled those used in EPA's E&P Waste Study and the API's Production Waste Study.

0305 Health And Safety

28878 **Predicting and managing the health risks of sour-gas wells.** Layton, D.W.; Cederwall, R.T. (Lawrence Livermore National Lab., CA (USA)). *Journal of the Air Pollution Control Association;* **37**: No. 10, 1185(Oct 1987). Contract W-7405-ENG-48.

The development of sour-gas resources in Canada and the United States has prompted concerns about the public health risks of accidental releases of gas contaminated with hydrogen sulfide (H_2S) from wells. This paper focuses on methods for improving the prediction and management of those risks. Data associated with the health effects of hydrogen sulfide are examined, and it is suggested that sublethal effects should be addressed in risk assessments of sour-gas wells along with the life-threatening effects normally considered. The demarcation of hazard zones around wells can be improved by using a statistical approach for estimating an upper-bound H_2S release rate; this rate can then be used in an atmospheric dispersion model to estimate maximum distances to downwind concentrations for lethal (300 ppmv) and sublethal (50 ppmv) effects resulting from an accidental release. A vertical release is found to have little impact, especially under stable atmospheric conditions; horizontal releases, on the other hand, result in the greatest downwind distances for health impacts. Management of health risks depends on a mix of safety technologies and contingency actions, such as well-ignition options and provision for post-release monitoring and assessment of ambient H_2S concentrations.

0350 Storage

28879 **Feasibility analysis and development of a foam-protected underground natural gas storage facility.** Witherspoon, P.A.; Radke, C.J.; Shikari, Y.; Pruess, K.; Persoff, P.; Benson, S.M.; Wu, Y.S. (Univ. of California, Berkeley (US)). pp 539-549 of AGA 1987 operating section proceedings. Arlington, VA; American Gas Association (1987). (CONF-8705164—).

From AGA distribution/transmission conference; Las Vegas, NV, USA (4 May 1987).

Technical Paper 87-DT-110.

Underground storage of natural gas gas been practiced for over 40 years as a cost-effective means of meeting peak demand. However, the volume of gas that must remain in the storage aquifer (base gas) is typically large compared to the quantity that is available for withdrawal (working gas). One way of improving the efficiency of gas storage operations is to keep the working gas closer to the withdrawal wells and to create a thicker gas saturated region. To achieve this, the mobility of the injected gas must be controlled. The authors are investigating the feasibility of using foam as a mobility control agent for gas storage operations. Specific concepts for using foam to improve gas storage operations range from improved injection/withdrawal well performance to the potential for creating isolated underground storage regions. This paper describes the efforts of the first year of the three-year research program that is being sponsored by the Gas Research Institute. Laboratory studies for identifying suitable foams and for improving their knowledge of foam behavior are being carried out. In addition, a mathematical model for simulating "foam-protected" gas storage operations and for designing "foam-protected" storage operations is being developed. Preliminary economic analyses indicate a significant reduction in gas storage costs in a successfully implemented "foam-protected" aquifer gas storage operation.

04 OIL SHALES AND TAR SANDS

0404 Oil Production, Recovery, And Refining

REFER ALSO TO CITATION(S) 28834

28880 **(WY—830705) Study on hydrodesulfurization of hydrocracked pitch from Athabaska bitumen: further test of the microwave process. Final report.** (W and Y Consultants Kingston Ltd., Ontario (Canada)). 5 Jul 1983. 24p. (MICROLOG—85-0956). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

The major objective is to establish the novel microwave catalytic processes in the hydrodesulfurization of pitch at low pressure and temperature. This novel approach was first developed for disposal of toxic organic chemicals. The process involves a combination of effects of microwave irradiation and metal powder/metal hydride powder catalysts. A number of potentially effective metal hydrides used as the catalyst/hydrogen atom source were prepared. Characterization of these metal hydrides was carried using x-ray powder diffraction technique. The overall experimental work was organized into four parts: to repeat experiments with metal powder and to develop a better method for the circulation of the gases within the reactor; to prepare a number of new metal hydrides and to compare their effectiveness with the old metal powder experiments; to develop better analytical techniques for the analysis of sulfur and for the determinations of the gaseous products in representative experiments; to carry out some preliminary experiments with other materials, including gas-oil and bitumen and model compounds for the purpose of gaining some basic understanding of the processes. Preliminary data were also obtained which showed the estimated costs of such a process in the commercial scale operations.

0405 Properties And Composition

REFER ALSO TO CITATION(S) 28834

0410 Environmental Aspects

28881 **Effects of organic wastes on water quality from processing of oil shale from the Green River Formation, Colorado, Utah, and Wyoming.** Leenheer, J.A.; Noyes, T.I. *United States Geological Survey, Professional Paper;* **75**: No. 1338, 1-56(1986).

A series of investigations was conducted during a 6-year research project to determine the nature and effects of organic wastes on water quality from processing oil shale from the Green River Formation. These investigations included retort-waste water and spent-shale characterization, determination of sorptive characteristics and chemical interactions between soil and spent shale, laboratory studies of microbiological degradation of organic constituents in retort waste water, onsite studies of water-quality effects resulting from in-situ oil-shale retorting in Wyoming and Colorado, and characterization of natural organic solutes in waters associated with oil shale. An analytical method, dissolved organic-carbon fractionation analysis, was developed to classify complex organic-solute mixtures found in natural waters and retort waste waters, into hydrophobic-acid, -base, and -neutral compound groups.

05 NUCLEAR FUELS

28882 Uranium Revitalization, Tailings Reclamation, and Enrichment Act of 1987. Senate, One Hundredth Congress, First Session. Washington, DC; Government Printing Office (1987). 140p.

The Committee on Energy and Natural Resources, having considered the same, reports favorably an original bill, to provide for a viable domestic uranium industry, to establish a program to fund reclamation and other remedial actions with respect to mill tailings at active uranium and thorium sites, to establish a wholly-owned Government corporation to manage the Nation's uranium enrichment enterprise, operating as a continuing, commercial enterprise on a profitable and efficient basis, and for other purposes, and recommends that the bill do pass. The purpose of the Uranium Revitalization, Tailings Reclamation and Enrichment Act of 1987, as reported by the Committee on Energy and Natural Resources, is to ensure an adequate long-term supply of domestic uranium and enrichment capacity for the Nation's nuclear power program.

0501 Reserves, Exploration, And Mining

REFER ALSO TO CITATION(S) 29704

0504 Feed Processing

REFER ALSO TO CITATION(S) 29445

28883 Out-of-core nuclear fuel cycle economic optimization for nonequilibrium cycles. Comes, S.A. Raleigh, NC; North Carolina State Univ. (1987). 199p. University Microfilms Order No. 87-07,891.

Thesis (Ph. D.).

A methodology and associated computer code was developed to determine near-optimum out-of-core fuel management strategies. The code, named OCEON (Out-of-Core Economic OptimizationN), identified feed-region sizes and enrichments, and partially burned fuel-reload strategies for each cycle of a multi-cycle planning horizon, subject to cycle-energy requirements and constraints on feed enrichments, discharge burnups, and the moderator temperature coefficient. A zero-dimensional reactor physics model, enhanced by a linear reactivity model to provide batch power shares, performs the initial feed enrichment, burnup and constraint evaluations, while a two-dimensional, nodal code is used to refine the calculations for the final solutions. The economic calculations are performed rapidly using an annuity-factor-based model. Use of Monte Carlo integer programming to select the optimum solutions allows for the determination of a family of near-optimum solutions, from which engineering judgment may be used to select an appropriate strategy. Results from various nonequilibrium cycle energy requirement cases typically show a large number of low-cost solutions near the optimum. This confirms that the Monte Carlo integer programming approach of generating a family of solutions will be most useful for selecting optimum strategies when other considerations, such as incore loading pattern concerns, must be addressed.

0505 Uranium Enrichment

REFER ALSO TO CITATION(S) 28883

28884 (K/CSD/TM—68) The POTS cascade transient code and the calculation of the times required to get production U-235 gradients at Oak Ridge and Paducah. Kelleher, D.M. Jr.; Ebel, R.A. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Mar 1988. Contract AC05-84OT21400. 24p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88007696/JAW.

This report describes the POTS Gaseous Diffusion Transient Analysis Code and how it was used to calculate the times that would be required to get production uranium-235 (U-235) gradients in the cascades at the Oak Ridge and Paducah Gaseous Diffusion Plants if the cascades were restarted after an extended shutdown. Version 3.0 of the POTS code, the method used to calculate the times, and plots showing how the U-235 gradients would change after the cascades were restarted are presented.

0509 Transport And Storage

REFER ALSO TO CITATION(S) 29699

28885 (SAND—87-2718C) Quality assurance aspects in using ductile cast iron for transportation casks. Sorenson, K.B.; Salzbrenner, R.J. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 8p. (CONF-880354—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88007110/JAW.

From Waste management '88; Tucson, AZ, USA (1 Mar 1988).

As part of a DOE base technology program, Sandia is assessing the applicability of using ductile cast iron (DCI) in transport casks. The methodology being used in this evaluation is based on fundamental fracture mechanics. This paper will describe the technical issues addressed in the Sandia program and how they relate to quality assurance. Results of experimental work, which relate fracture toughness to material microstructure, will be presented. To date, ferritic materials (including DCI) have not been certified for this application. The principal issue in using ferritic materials is that they can (under certain combined mechanical and environmental conditions) fail in a low energy, brittle type fashion, particularly in the vicinity of a flaw. Also, for thick-walled castings, inevitable variability in material microstructure results in mechanical property variability. To qualify this material for use in transport casks, it is necessary to demonstrate not only that the possibility of brittle fracture is precluded, but also that the results are repeatable. This is, the development approach (design, fabrication, and testing) used for a prototype cask for proof tests must be transferable to each production cask.

0520 Waste Management

REFER ALSO TO CITATION(S) 29281, 29434, 29439, 29447, 29448, 29699

28886 (ANL/EES-TM—342) Radioactive waste isolation in salt:. Ditmars, J.D.; Baecher, G.B.; Edgar, D.E.; Dowding, C.H. (Argonne National Lab., IL (USA). Energy and Environmental Systems Div.). Mar 1988. Contract W-31109-ENG-38. 97p.

The approach presumes that measurements are undertaken to support performance predictions. A quantitative performance objective like groundwater travel time is compared with performance predictions. The approach recognizes that such predictions are uncertain because the measurements upon which they are based are uncertain. The effectiveness of measurement activities is quantified by an index, β, that reflects the number of standard deviations separating the best estimate of performance from the performance objective. Measurements that reduce the uncertainty in predictions lead to increased values of β. Evaluating β for a particular measurement scheme requires identifying the measured quantities that significantly affect prediction uncertainty. Sources of uncertainty are spatial variation, noise, estimation error, and measurement bias. Changing the measurement scheme to increase β increases the likelihood of a performance objective being achieved or exceeded. The application of the β-index method to the Richton dome site in Mississippi focuses on uncertainties in hydraulic conductivity data in relation to groundwater travel time predictions. The β values for four different measurement schemes for hydraulic conductivity are determined. 44 refs., 14 figs., 15 tabs.

28887 (BNL-NUREG—40882) Modeling the flow of water in and around shallow burial trenches. Suen, C.J. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 15p. (CONF-880201—28). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88007398/JAW.

From Waste management '88: symposium on radioactive waste management; Tucson, AZ, USA (26 Feb 1988).

Water flow through a generic low-level waste burial trench has been modeled for a vertical cross-section perpendicular to the longitudinal axis of an elongated trenched, using the finite element code, FEMWATER, in two-dimensional vertical mode. The grid consists of 513 nodes and 468 variable-size quadrilateral elements, and the simulation domain is about 56 m (H) {times} 34 m (V). The traench, which is situated in the unsaturated zone, measures approximately 28 m wide and 10 m deep in cross-section, and is composed of three types of soil - a high-conductivity gravel cap on top, a low-conductivity clay layer beneath it, and backfill soil in the waste burial region. The rest of the domain is made up of undisturbed soil. Different cases have been simulated by varying boundary conditions, geometry and hydraulic properties. These results are used in radionuclide transport calculations to determine the "source term" (4). In addition, numerical experiments provide valuable information in trench design, such as, the geometry of the moisture barrier. Results from these experiments indicates that a moderate extension (8 m) of the clay layer beyond the sides of the trench can significantly reduce the net water flow (by 42%). They also show that sparsely distributed waste package have minimal effect on the net flow through the trench. 10 refs., 7 figs., 3 tabs.

28888 **(CIN-AI—N.10) Radioactive Waste management - v. 1. Overview of treatment and disposal.** (Centro de Informacoes Nucleares, Rio de Janeiro (Brazil)). 1987. 54p. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88702500/JAW.

The state of the art for each stage and activities correlated to the nuclear fuel cycle, describing the activities of main countries of the world in this area, is presented. In this volume, the principles which described the several sources of radioactive wastes from nuclear industry, the standardization of waste categories, the strategies adopted for treatment and disposal, the repository types and the practices and proposals of several countries in this field, are presented. (M.C.K.).

28889 **(CIN-AI—N.11) Radioactive waste management - v. 2. Overview of main countries as for nuclear fuel cycle.** (Centro de Informacoes Nucleares, Rio de Janeiro (Brazil)). 1987. 78p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702501/JAW.

In this second part, the program of waste management of non-military origin of the following countries: USA, United Kingdom, France, Canada, Federal Republic of Germany, and Japan, is presented. For each country, a brief overview on its nuclear program, to identify the reason of the major emphasis done by this country for a specific waste management, is presented. The legislation control, the classification, the treatment and, the options for waste disposal are also presented. (M.C.K.).

28890 (DOE/ER/75172—5, pp 58) **Redesign of the spent fuel storage racks at the Trojan Nuclear Plant.** Stump, K. (Oregon State Univ., Corvallis (USA)). 1987. NTIS, PC A06/MF A01. Order Number DE88005041/JAW. (CONF-8703231—Summs.).

From Western region American Nuclear Society student conference: nuclear technology for the year 2000; Albuquerque, NM, USA (19 Mar 1987).

The spent fuel pool (SFP) at the Trojan Nuclear Plant located near Prescott, Oregon, was originally designed to hold 1.33 cores worth of spent fuel assemblies. Due to the delay in the site selection and preparation process for the spent fuel repository, the SFP storage capacity was increased in 1978 from 260 assemblies to 651 assemblies and in 1983 was increased again from 651 to 1408 assemblies to allow Trojan to continue operations through the year 2003 with a full core reserve in the SFP. Now it appears unlikely that a high level waste repository will be in operation before 2010. This indicates that a further capacity increase in the SFP is required to allow commercial operation until 2010, at which time the repository should be open to receive spent fuel. To accomplish this, an increase of seven times the original SFP capacity of 260 assemblies is needed. This paper presents a spent fuel assembly rack design that enables the required capacity increase in the SFP to be met. By the use of a boron carbide - silicon polymer inside a titanium/vanadium honeycomb as a neutron absorber between the fuel assemblies and by increasing the metal to water ratio of the spent fuel pool to harden the neutron energy spectrum the capacity of the SFP is increased to 1880 assemblies for an increase of 7.23 times the original spent fuel pool capacity. The multiplication factor for the pool with every fuel assembly slot filled in the new rack system is 0.62; well below the NRC regulatory limit of keff $<$ 0.95. The capacity increase with allow the commercial operation of the Trojan Nuclear Plant through 2010 with a full core reserve in the spent fuel pool.

28891 **(DOE/HWP—38) Implementation plan: Quality assurance requirements: Hazardous Waste Remedial Actions Program.** Horne, T.E. (Oak Ridge National Lab., TN (USA). Hazwrap Support Contractor Office). Nov 1987. Contract AC05-84OR21400. 45p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88007458/JAW.

This document establishes the Quality Assurance (QA) Program requirements for the Hazards Waste remedial Actions Program (HASWRAP) for ensuring, with a high degree of confidence, that program objectives will be achieved as planned. The QA Program is introduced in Sect. 1. The HAZWRAP Support Contractor Office (SCO) functional organization and QA responsibilities are shown in Sect. 2. QA program requirements are contained in Sect. 3. These requiremens are pased on the American national Standard, American National Standards Institute/American Society of Mechanical Engineers NQA-1 Quality Assurance Program Requirements for Nuclear Facilities. The 18 elements defined in the standard are tailored to HAZWRAP's needs. The QA program requirements are delineated under the major headings: Quality Assurance Program, Organization, and Control of Quality;two additional program requirements, Software Quality Assurance and Problem Prevention, are included. Definitions of QA terms and the list of formal reports published by the HAZWRAP SCO are included as appendixes. 8 refs., 1 fig.

28892 **(DOE/RW—0165) Site characterization plan overview: reference repository location, Hanford Site, Washington: Consultation draft:.** (USDOE Office of Civilian Radioactive Waste Management, Washington, DC). Jan 1988. 137p.

As part of the process for siting the nation's first geologic repository for radioactive waste, the Department of Energy (DOE) is preparing a site characterization plan for the Hanford site in Benton County, Washington. As a step in the preparation of that plan, the DOE has provided, for information and review, a consultation draft of the plan to the State of Washington, the affected Indian Tribes - the Confederated Tribes of the Umatilla Indian Reservation, the Nez Perce Indian Tribe, and the Yakima Indian Nation - and the US Nuclear Regulatory Commission. The Hanford site is one of three sites that the DOE currently plans to characterize;the other sites are the Deaf Smith County site in Texas and the Yucca Mountain site in Nevada. After site characterization has been completed and its results evaluated, the DOE will identify from among the three characterized sites the site that is preferred for the repository. The overview presented here consists of brief summaries of important topics covered in the consulation draft of the site characterization plan;it is not a substitute for the site characterization plan. The arrangement of the overview is similar to that of the plan itself, with breif descriptions of the dispoal system - the site, the repository, and the waste package - preceding the discussion of the characterization program to be carried out at the Hanford site. It is intended primarily for the management staff of organizations involved in the DOE's repository program or other persons who might wish to understand the general scope of the site-characterization program, the activities to be conducted, and the facilities to be constructed rather than the technical details of site characterization.

28893 **(DOE/RW—0177) Environmental Regulatory Compliance Plan for site: Draft characterization of the Yucca Mountain site:.** (USDOE Nevada Operations Office, Las Vegas). Jan 1988. Contract AC08-87NV10576. 231p. H; GPO Dep. Order Number TI88006889/JAW.

The objective of the EMMP is to document compliance with the NWPA. To do so, a summary description of site characterization activites is provided, based on the consultation draft of

the SCP. Subsequent chpaters identify those technical areas having the potential to be impacted by site characterization activities and the monitoring plans proposed to identify whether those impacts acutally occur. Should monitoring confirm the potential for significant adverse impact, mitigative measures will be developed. In the context of site characterization, mitigation is defined as those changes in site characterization activities that serve to avoid or minimize, to the maximum extent practicle, any significant adverse environmental impacts. Although site characterization activies involve both surface and subsurface activities, it is the surface-based aspect of site characterization that is addressed in detailed by the EMMP. The schedule and duration of these activities is given in the consultation draft of the SCP. A breif summary of all proposed activities is given in the EMMP. 10 refs., 8 figs.

28894 **(DOE/RW—0184-Vol.2) Characteristics of spent fuel, high-level waste, and other radioactive wastes which may require long-term isolation: Appendix 1A, ORIGEN2 overview, Appendix 1B, ORIGEN2 library data, Appendix 1C, ORIGEN2 interpolation functions.** (USDOE Office of Civilian Radioactive Waste Management, Washington, DC). Dec 1987. 68p.

The purpose of this report, and the information contained in the associatted computerized data bases, is to establiah the DOE/OCRWM reference characteristics of the radioactive waste materials that may be accepted by DOE for emplacement in the mined geologic disposal system. This report provides relevant technical data for use by DOE and its supporting contractors and is not intended to be a policy document. This document is backed up by five PC-compatible data bases, written in a user-oriented, menu-driven format, which were developed for this purpose. The data bases are the LWR Assemblies Data Base;the LWR Radiological Data Base;the LWR Quantities Data Base;the LWR NFA Hardware Data Base;and the High-Level Waste Data Base. The above data bases may be ordered using the included form. An introductory information diskette can be found inside the back cover of this report. It provides a brief introduction to each of these five PC data bases. Volume 2 describes the ORIGEN2 computer code.

28895 **(DOE/RW—0184-Vol.3) Characteristics of spent fuel, high-level waste, and other radioactive wastes which may require long-term isolation: Appendix 2A, Physical descriptions of LWR [Light-Water Reactor] fuel assemblies.** (USDOE Office of Civilian Radioactive Waste Management, Washington, DC). Dec 1987. 340p.

This appendix includes a four-page Physical Description report for each assembly type identified from the current data. Where available, a drawing of an assembly follows the appropriate Physical Description report. If no drawing is available for an assembly, a cross-reference to a similar assembly is provided if possible. For Advanced Nuclear Fuels, Babcock and Wilcox, Combustion Engineering, and Westinghouse assemblies, information was obtained via subcontracts with these fuel vendors. Data for some assembly types are not available. For such assemblies, the information shown in this report was obtained from the open literature and by inference from reload fuels made by other vendors. Efforts to obtain additional information are continuing. Individual Physical Description reports can be generated interactively through the menu-driven LWR Assemblies Data Base system. These reports can be viewed on the screen or directed to a printer. Special reports and compilations of specific data items can be produced on request.

28896 **(DOE/RW—0184-Vol.4) Characteristics of spent fuel, high-level waste, and other radioactive wastes which may require long-term isolation: Appendix 2B, User's guide to the LWR assemblies data base, Appendix 2C, User's guide to the LWR radiological data base, Appendix 2D, User's guide to the LWR quantities data base.** (USDOE Office of Civilian Radioactive Waste Management, Washington, DC). Dec 1987. 188p. OSTI, PO Bx 62, Oak Ridge, TN 37831. Order Number TI88007363/JAW.

This User's Guide for the LWR Assemblies data base system is part of the Characteristics Data Base being developed under the Waste Systems Data Development Program. The objective of the LWR Assemblies data base is to provide access at the personal computer level to information about fuel assemblies used in light-water reactors. The information available is physical descriptions of intact fuel assemblies and radiological descriptions of spent fuel disassembly hardware. The LWR Assemblies data base is a user-oriented menu driven system. Each menu is instructive about its use. Section 5 of this guide provides a sample session with the data base to assist the user.

28897 **(DOE/RW—0184-Vol.5) Characteristics of spent fuel, high-level waste, and other radioactive wastes which may require long-term isolation: Appendix 2E, Physical descriptions of LWR nonfuel assembly hardware, Appendix 2F, User's guide to the LWR nonfuel assembly data base.** (USDOE Office of Civilian Radioactive Waste Management, Washington, DC). Dec 1987. 266p.

This appendix includes a two to three page Physical Description report for each Non-fuel Assembly (NFA) Hardware item identified from the current data. Information was obtained via subcontracts with these NFA hardware vendors: Babcock and Wildox, Combustion Engineering and Westinghouse. Data for some NFA hardware are not available. For such hardware, the information shown in this report was obtained from the open literature. Efforts to obtain additional information are continuing. NFA hardware can be grouped into six categories: BWR Channels, Control Elements, Guide Tube Plugs/Orifice Rods, Instrumentation, Neutron Poisons, and Neutron Sources. This appendix lists Physical Description reports alphabetically by vendor within each category. Individual Physical Description reports can be generated interactively through the menu-driven LWR Non-Fuel Assembly Hardware Data Base system. These reports can be viewed on the screen, directed to a printer, or saved in a text file for later use. Special reports and compilations of specific data items can be produced on request.

28898 **(DOE/RW—0186) Implementation plan for deployment of Federal Interim Storage facilities for commercial spent nuclear fuel.** (USDOE Office of Civilian Radioactive Waste Management, Washington, DC). Feb 1988. 18p.

This document is the fifth annual report on plans for providing Federal Interim Storage (FIS) capacity. References are made to the first, second, third, and fourth annual reports, as necessary. Background factors and aspects that were considered in the development of this deployment plan and activities and interactions considered to be required to implement an FIS program are discussed. A generic description of the approach that the Department plans to follow in deploying FIS facilities is also described. 18 refs., 1 fig., 1 tab.

28899 **(EGG-M—02686) Results of comparison testing of the General Electric and Westinghouse-Hittman compactors.** Larsen, M.M.; Aldrich, W.C. (EG and G Idaho, Inc., Idaho Falls (USA)). 1986. Contract AC07-76ID01570. 24p. (CONF-8602160—1).

From Radwaste management workshop; Savannah River, GA, USA (9 Feb 1986).

EG & G Idaho has conducted a compactor testing program in support of potential compaction activities at the Idaho National Engineering Laboratory (INEL). The capabilities of the Westinghouse-Hittman compactor and the General Electric compactor were tested and compared, and the findings are presented in this report. Supercompaction appears to be an excellent method for volume reduction of dry active waste (DAW) generated at nuclear facilities. There is no single nuclear facility generating enough DAW to keep a super compactor in full-time operation. An exception might be a group of nuclear facilities in close proximity jointly sharing in the use of a super compactor. INEL may also be an exception. Transuranic (TRU) waste, primarily from Rocky Flats, has been retrievably stored at the INEL since 1970. Currently, there are over 120,000 55-gal drums and 9000 boxes (4 x 4 x 7 ft) of this TRU waste. 7 figs., 4 tabs.

28900 **(EPRI-NP—5670) Below regulatory concern owners group: Evaluation of candidate waste streams: Final report.** Daloisio, G.S.; Deltete, C.P.; Crook, M.R. (Analytical Resources, Inc., Sinking Springs, PA (USA)). Mar 1988. 125p. Research Reports Center, Box 50490, PaloAlto, CA 94303. Order Number TI88920236/JAW.

There are several waste streams produced at nuclear power plants that contain very low radioactivity concentrations and could be classified as Below Regulatory Concern (BRC), thus exempting that waste from low-level waste disposal requirements. The Electric Power Research Institute (EPRI) has embarked on a program to develop generic BRC exemptions for specific waste streams. In order to focus the finite resources of time and money on those waste streams which would provide the maximum benefit to the industry, an evaluation of potential BRC waste streams was performed. This evaluation provides a systematic and documented approach to identify candidate BRC waste streams for inclusion in the EPRI BRC program. The report identifies potential BRC waste streams, defines appropriate evaluation/selection criteria, and provides an evaluation of each waste stream with respect to these criteria. The final result of this evaluation is a prioritized list of BWR and PWR waste streams, in decreasing order of attractiveness, suitable for inclusion in the EPRI BRC program. 7 refs., 15 figs., 18 tabs.

28901 **(INIS-BR—993) Packages for radiactive waste disposal.** Oliveira, R. de. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Engenharia Civil). 1983. 160p. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88702577/JAW.

The development of multi-stage type package for sea disposal of compactable nuclear wastes, is presented. The basic requirements for the project followed the NEA and IAEA recommendations and observations of the solutions adopted by others countries. The packages of preliminary design was analysed, by computer, under several conditions arising out of its nature, as well as their conditions descent, dumping and durability in the deep of sea. The designed pressure equalization mechanic and the effect compacting on the package, by prototypes and specific tests, were studied. These prototypes were also submitted to the transport tests of the 'Regulament for the Safe Transport of Radioactive Materials'. Based on results of the testes and the re-evaluation of the preliminary design, final indications and specifications for excuting the package design, are presented. (M.C.K.).

28902 **(INIS-BR—1006) Thermal-mechanical aspects for radioactive waste storage into underground caverns.** Vieira, Alvaro. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Engenharia Civil). Dec 1985. 169p. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88702590/JAW.

The thermal and mechanical behaviors of rock mass by analytical models, considering transient effects of the heat generation from radioactive wastes, are analysed. The models were applied to Brazilian gneissic type of rock, considering the usual design of vitrified waste cylinders individually installed into conveniently spaced holes. (M.C.K.).

28903 **(LA—10952-MS) Preliminary report on sorption modeling.** Fuentes, H.R.; Polzer, W.L.; Gruber, J.; Lauctes, B.; Essington, E.H. (Los Alamos National Lab., NM (USA)). Aug 1987. Contract W-7405-ENG-36. 353p.

The generic objective of this study is to inventory and model batch sortpion data obtained for the Nevada Nuclear Waste Storage Investigations Projects by the Los Alamos National Laboratory. This report addresses the modeling by various isotherms of data sets inventoried from about 1500 data enetries, potential occurrence of precipitation in the sorption experiments, and evaluation of a computer code to study changes in chemical isolation caused by changes in the chemistry of the porous media. 20 refs., 4 figs., 31 tabs.

28904 **(LA-UR—88-391) Effects of vegetation and soil-surface cover treatments on the hydrologic behavior of low-level waste trench caps.** Lopez, E.A.; Barnes, F.J.; Antonio, E.J. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 14p. (CONF-880201—23). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006475/JAW.

From Waste management '88: symposium on radioactive waste management; Tucson, AZ, USA (26 Feb 1988).

Preliminary results are presented on a three-year field study at Los Alamos National Laboratory to evaluate the influence of different low-level radioactive waste trench cap designs on water balance under natural precipitation. Erosion plots having two different vegetative covers (shrubs and grasses) and with either gravel-mulched or unmulched soil surface treatments have been established on three different soil profiles on a decommissioned waste site. Total runoff and soil loss from each plot is measured after each precipitation event. Soil moisture is measured biweekly while plant canopy cover is measured seasonally. Preliminary results from the first year show that the application of a gravel mulch reduced runoff by 73 to 90%. Total soil loss was reduced by 83 to 93% by the mulch treatment. On unmulched plots, grass cover reduced both runoff and soil loss by about 50% compared to the shrub plots. Continued monitoring of the study site will provide data that will be used to analyze complex interactions between independent variables such rainfall amount and intensity, antecedent soil moisture, and soil and vegetation factors, as they influence water balance, and soil erosion. 18 refs., 2 figs., 3 tabs.

28905 **(NUREG—1199-Rev.1) Standard format and content of a license application for a low-level radioactive waste disposal facility: Safety analysis report.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards). Jan 1988. 166p. NTIS, PC A08/MF A01 - GPO. Order Number TI88900479/JAW.

This document discusses the information that should be provided in the Safety Analysis Report and establishes a uniform format for presenting the information necessary to fulfill the licensing requirements for land disposal of radioactive waste called for in 10 CFR 61. The uniform format will (1) help ensure that the Safety Analysis Report contains the information required by 10 CFR 61, (2) aid the applicant and NRC staff in ensuring that the information is complete, (3) help persons reading the Safety Analysis Report to locate information, and (4) contribute to shortening the time needed for the review process.

28906 **(NUREG/CR—4807) Surface-complexation modeling of radionuclide adsorption in subsurface environments.** Kent, D.B.; Tripathi, V.S.; Ball, N.B.; Leckie, J.O.; Siegel, M.D. (Stanford Univ., CA (USA). Dept. of Civil Engineering; Sandia National Labs., Albuquerque, NM (USA)). Mar 1988. Contract AC04-76DP00789. 128p. (SAND—86-7175).

Requirements for applying the surface-complexation modeling approach to simulating radionuclide adsorption onto geologic materials are discussed. Accurate description of adsorption behavior requires that chemical properties of both adsorbent and adsorbate be characterized in conjunction with determinations of extent of adsorption. Critical chemical properties of adsorbents include dissolution and oxidation/reduction behavior, types and densities of adsorption sites, and interaction of sites with solution components. Important adsorbate properties include hydrolysis, complexation, oxidation/reduction, and oligomerization. Adsorption behavior is described by a set of chemical reactions and binding constants between: adsorption sites and solution components, adsorbate and solution components, and adsorbate and adsorption sites. Methods for implementing such an approach are discussed;examples based on solute adsorption onto oxides are presented. The approach currently used to simulate sorption onto geologic materials, i.e., the determination of distribution coefficients, yields estimates that are disparate and subject to large errors. Implementation of the surface-complexation modeling approach would greatly improve the predictability of the role of adsorption in regulating radionuclide transport in subsurface environments. Research efforts should be directed towards understanding radionuclide adsorption onto fixed-charge minerals (e.g., clays), carbonate minerals, and poly-mineralic assemblages representative of those present at potential repositories. 123 refs., 19 figs., 18 tabs.

28907 **(PNL—5977) WASTES: Waste System Transportation and Economic Simulation--Version 2:.** Sovers, R.A.; Shay, M.R.; Ouderkirk, S.J.; McNair, G.W.;Eagle, B.G. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1988. Contract AC06-76RL01830. 45p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006834/JAW.

The Waste System Transportation and Economic Simulation (WASTES) Technical Reference Manual was written to describe

and document the algorithms used within the WASTES model as implemented in Version 2.23. The manual will serve as a reference for users of the WASTES system. The intended audience for this manual are knowledgeable users of WASTES who have an interest in the underlying principles and algorithms used within the WASTES model. Each algorithm is described in nonprogrammers terminology, and the source and uncertainties of the constants in use by these algorithms are described. The manual also describes the general philosophy and rules used to: 1) determine the allocation and priority of spent fuel generation sources to facility destinations, 2) calculate transportation costs, and 3) estimate the cost of at-reactor ex-pool storage. A detailed description of the implementation of many of the algorithms is also included in the WASTES Programmers Reference Manual (Shay and Buxbaum 1986a). This manual is separated into sections based on the general usage of the algorithms being discussed. 8 refs., 14 figs., 2 tabs.

28908 **(PNL—6396) Characterization of simulated low-level waste grout produced in a pilot-scale test.** Lokken, R.O.; Reimus, M.A.; Martin, P.F.C.; Geldart, S.E. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1988. Contract AC06-76RL01830. 55p.

The objectives of a pilot-scale grout test were to determine the homogeneity of the grout produced under conditions similar to those planned for the TGF, to evaluate performance of candidate grout processing equipment for the TGF, and to evaluate properties of grout that was produced during continuous operation over an extended time period and cured in a large monolith. This report addresses the first and third objectives. Tests were conducted on pilot-scale grout slurry, simulated waste solution, dry solids blend samples, and cured grout samples. Grout slurry collected at two points during the pilot-scale test and slurry produced in the laboratory were characterized by measuring rheology, drainable liquid, and penetration resistance. Cured grout samples included samples collected during the pilot-scale test and cured in the laboratory, samples produced in the laboratory, samples obtained from tubes inserted into the monolith, and samples from cored sections of the monolith. Tests conducted on the cured samples included compressive strength, density, ultrasonic pulse velocity, leachability, and microstructural characterization. 10 refs., 12 figs., 16 tabs.

28909 **(PNL—6467-Vol.1) Ground-water monitoring compliance projects for Hanford Site facilities:.** (Pacific Northwest Lab., Richland, WA (USA)). May 1987. Contract AC06-76RL01830. 56p. NTIS, PC A04/MF A01; GPO Dep. Order Number DE88007367/JAW.

This report documents the progress of four Hanford Site grond-water monitoring projects for the tiem period from January 1 to March 31, 1987. The four disposal facilites are: the 300 Area Process Trenches, the 1983-H Solar Evaporation Basins, the 200 Area Low-Level Burial Grounds, and the Nonradioactive Dangerous Waste (NRDW) Landfill. This report is the third in a series of periodic status reports. During this reporting period, the 300 Area, 183-H, and NRDW Landfill projects completed all monitoring wells that were part of the initial drilling phase and incorporated them into the ground-water monitoring networks for each site. Characterization reports have been drafted for the three projects and will be released to the State and USEPA in the next quarter. Analytical results for the threee sites for which wells have been drilled prdouced no deviations from the established trends. Results from the NRDW Landfill indicate that the facility has not impacted the ground-water qualtiy in the area. Fluctuations in concentrations of specific parameters at the 300 Area site are generally attributed to specific known activities conducted in the area. Fluctuations in specific parameter concentrations in wells in the vicinity of the 183-H facility are attributed to water table fluctuations associated iwth river stage. 12 refs., 29 figs., 4 tabs.

28910 **(PNL—6469) Ground-water monitoring compliance projects for Hanford Site facilities:.** (Pacific Northwest Lab., Richland, WA (USA)). Nov 1987. Contract AC06-76RL01830. 84p. NTIS, PC A05/MF A01; GPO Dep. Order Number DE88007368/JAW.

This report documents the progress of four Hanford Site ground-water monitoring projects for the period from July 1 to September 310, 1987. The four disposal facilities are the 300 Area Process Trenches, 183-H Solar Evaporation Basins, 200 Area Low-Level Burial Grounds, and Nonradioactive Dangerous Waste (NRDW) Landfill. This report is the fifth in a series of periodic status reports. During this reporting period, field activities consisted of completing repairs on five monitoring wells originally present around the 183-H Basins and completing construction of 25 monitoring wells around the 200 Area Burial Grounds. The 14 wells in the 200 East Area were completed by Kaiser Engineers Hanford (KEH) and the 11 wells in the 200 West Area were compelted by ONWEGO Well Drilling. The NRDW Landfill interim characterization report was submitted to the WDOE and the USEPA in August 1987. Analytical results for the 300 Area, 183-H, and the NRDW Landfill indicate no deviations from previously established trends. Results from the NRDW Land-fill indiate that the facility has no effect on the ground-water quality beneath the facility, except for the detection of coliform bacteria. A possible source of this contamination is the solid-waste lanfill (SWL) adjacent to. the NRDW Landfill. Ground-water monitoring data for the NRDW and SWL will be evaluated together in the future. Aquifer testing was completed in the 25 new wells surrounding the 200 Area buiral grounds. 13 refs., 19 refs., 13 tabs.

28911 **(SAND—87-7032) Subseabed nuclear waste disposal ship conceptual design and accident analysis: 1986 status report.** Hutchinson, B.L. (Glosten Associates, Inc., Seattle, WA (USA)). Feb 1988. Contract AC04-76DP00789. 362p. NTIS, PC A16/MF A01. Order Number DE88007494/JAW.

The conceptual design for the high-level waste transport and emplacement ship incorporates features designed to provide exceptional safety with respect of major marine accidents such as collisions, groundings, fire and sinking. The conceptual design incorporates a new form of structural collision protection which will prevent penetration into the cargo space by all ships with speeds less than 24 knots, and many ships with speeds greater than 24 knots. The urethane foam, which acts as the plastic foundation for the outer steel membrane in the collision protection system, also provides permanent buoyancy equal to 74% of the loaded ship weight. The permanent buoyancy provided by the foam in the collision protection system, together with urethane foam provided in other spaces, exceeds the loaded ship weight by over 24%. Even if the ship were cut in two, any portion containing high-level waste cargo would remain afloat. Through the use of high temperature insulation, the ship is demonstrated to be capable of surviving severe fire exposure for periods exceeding 72 hours. The results of a probabilistic safety assessment indicate that probabilities for a collision accident resulting in submergence of HLW cargo is less than 5.9×10^{-10} per outbound transit. Following a technology review and assessment, subjective probabilities for recovery of high-level waste cargo following a marine accident were estimated. 66 refs., 114 figs., 89 tabs.

28912 **(USGS-OFR—87-596) Earthquake location data for the southern Great Basin of Nevada and California: 1984 through 1986.** Harmsen, S.C.; Rogers, A.M. (Geological Survey, Denver, CO (USA)). 1987. Contract AI08-78ET44802. 96p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88007077/JAW.

This report presents data in map and table form for earthquake parameters such as hypocentral coordinates and magnitudes for earthquakes located by the southern Great Basin Seismic network for the time period January 1, 1984, through December 31, 1986. These maps show concentrations of earthquakes in regions previously noted to be seismically active, including the Pahranagat Shear Zone, Pahroc Mountains, southern Nevada Test Site, Timber Mountain, Black Mountain, Gold Mountain, Montezuma Range, and Grapevine Mountains. A concentration of earthquake activity in the Reveille Range was observed in 1986, in a previously inactive area. The northern Nevada Test Site had fewer earthquakes than a comparable area of the southern Nevada Test Site, indicating that the low-yield nuclear testing program is not currently triggering significant numbers of aftershocks. Eight microearthquakes occurred at Yucca Mountain during the 1984-1986 monitoring period. Depths of focus for well-located earthquakes continue to indicate a bimodal distribution, with peaks at 1 to 2 and 8 to 9 km below sea-level and a local minimum at 4 to 5 km. Focal mecha-

nisms range from strike slip to normal slip. No dependence of slip mode on depth or magnitude is evident. 8 refs., 46 figs., 5 tabs.

28913 **Empirical correlations from waste grout formulation data.** Tallent, O.K.; McDaniel, E.W.; Dodson, K.E.; Godsey, T.T. (Oak Ridge National Lab., Chemical Technology Div., P.O. Box X, Oak Ridge, TN 37831 (USA)). *Nuclear Technology;* **79**: No. 3, 348-358(Dec 1987). Contract AC05-84OR21400.

Data correlations have demonstrated systematic relationships between important variables in hydrofracture grout formulation. The data are taken from an investigation to determine conditions for eliminating drainable water from the grout system. The two most important variables affecting drainable water are the amounts of Attapulgite-150 clay in the dry-solids blends and the ratios in which the blends are mixed with the waste. Empirical equations were developed relating (a) volume percent of drainable water, (b) time for free water adsorption, (c) weight percent of clay, (d) dry-blend liquid-waste mix ratio, (e) compressive strength, (f) weight percent of fly ash, and (g) pumping flow rate required for turbulent flow through 51-mm-i.d. pipe. The equations allow predictions of properties within the compositional range of the investigation from which the data were obtained. They also provide a relatively simple method that can be used to improve future test design, eliminate superfluous testing, decrease costs, and increase overall efficiency of individual investigations.

28914 **Two-stage vesiculation in the Cohassett flow of the Grande Ronde basalt, south-central Washington.** McMillan, K.; Cross, R.W.; Long, P.E. (Rockwell Hanford Operations, Richland, WA (USA)). *Geology;* **15**: No. 9, 809-812(Sep 1987). Contract AC06-77RL01030.

The Cohassett flow in south-central Washington is considered a possible host for a nuclear waste repository at the Hanford Site and is being investigated as part of the Basalt Waste Isolation Project. The Cohassett flow of the Grande Ronde basalt contains two vesicular zones separated by 24 m of dense, sparsely vesicular basalt. The vesicular zones represent accumulations of upward-migrating bubbles sequentially frozen-in by the downward passage of the upper solidification front. The separation of the two zones suggests a hiatus in the exsolution of aqueous vapor from the lava. The flow-top vesicular zone formed during and immediately following emplacement of the flow from vapor bubbles nucleated during ascent and eruption, whereas the internal vesicular zone formed after emplacement from bubbles apparently nucleated at the lower solidification front. Homogeneous nucleation of vapor was probably initially driven by large oversaturation pressures in the erupting lava. After emplacement, heterogeneous nucleation of vapor was probably initiated by crystallization in the margins of the flow.

28915 **Mechanistic modelling of long-term leaching behavior of cement-based radioactive low-level waste forms.** Nimnual, S.; Colombo, P.; Wacks, M.E. (Brookhaven National Lab., Upton, NY 11973). pp v of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona (1987). (CONF-870306—).

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

The application of multi-concentration diffusion (MCD) group mathematical modelling to the long-term leaching behavior of cement-based radioactive waste forms is described. The modelling is illustrated by analyzing hypothetical cases using transport mechanisms such as molecular diffusion, ionic migration and convective flow for release of SR-85 from a solidified waste form. The group parameters, which describe the transport mechanisms, are derived from the classical electrochemistry concept of ion transport in dilute electrolytic solutions. The numerical analysis is based on the Crank-Nicolson Implicit Method, which assures the stability of the equation at practical time intervals. The boundary conditions are based on the experimental results. The results show that, for a short time period of leaching in demineralized water, the leaching behavior follows the predominating diffusion mechanism. After this point, the role of other processes are apparent and continue until all radionuclides in the cement waste form are leached. When compared to the Semi-Infinite Diffusion model, which is based on a pure diffusion mechanism, the MCD model predicts higher leach rates.

28916 **Organic compounds at the SRP old burial ground for low level radioactive waste.** Oblath, S.B. (E. I. du Pont de Nemours and Co., Savannah River Lab., Aiken, SC 29808 (USA)). pp v of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—). Contract AC09-76SR00001.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

Between 1953 and 1972, the Savannah River Plant (SRP) disposed of its solid, low-level radioactive waste in a 31 hectare shallow land burial site. A grid of 63 monitoring wells covering the site were used to sample for organic species in the groundwater which might enhance the mobility of radionuclides in the soil/water system. Total organic carbon (TOC) measurements were used as a screening method to select which wells should be used for oxalates, tri-n-butyl phosphate, and EDTA. More thorough analyses were performed using gas chromatography and mass spectrometry for a number of the wells. Using this procedure over 60 compounds were identified. Spent solvents, scintillation wastes, and decomposing cellulosic wastes are believed to be the primary sources. None of the compounds were identified as strong complexing agents which would enhance migration. Preliminary experiments indicated that as much as 40% of the organic carbon may be humic material. These substances were not further characterized. However, humic materials have been implicated in increasing mobility of radionuclides in soil/water systems.

28917 **Immobilization of mixed waste.** Gilliam, T.M. (Oak Ridge National Lab., Oak Ridge, TN 37831 (USA)). pp v of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—). Contract AC05-84OR21400.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

A fundamental relationship between ANS 16.1 and EP-Tox leach results has been developed and experimental data presented verifying the relationship for solidified waste products. The relationship can be used as a powerful tool for quality assurance during disposal operations;to guide formulation development efforts;and to expand existing data bases to a wider variety of mixed wastes.

28918 **Stabilization of mixed waste at the Idaho National Engineering Laboratory.** Boehmer, A.M.; Gillins, R.L.; Larsen, M.M. (Idaho National Engineering Lab., EG and G Idaho, Inc., P.O. Box 1625, Idaho Falls, ID 83415 (USA)). pp v of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—). Contract AC07-76ID01570.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

EG and G Idaho, Inc. has initiated a program to develop safe, efficient, cost-effective treatment methods for the stabilization of some of the hazardous and mixed wastes generated at the Idaho National Engineering Laboratory. Lab-scale testing has shown that Extraction Procedure toxic wastes can be successfully stabilized by solidification, using various binders to produce nontoxic, stable waste forms for safe, long-term disposal as either landfill waste or low-level radioactive waste, depending upon the radioactivity content. This paper presents the results of drum-scale solidification testing conducted on hazardous, low-level incinerator flyash generated at the Waste Experimental Reduction Facility. The drum-scale test program was conducted to verify that lab-scale results could be successfully adapted into a production operation.

28919 **Preliminary assessment of mixed hazardous and radioactive inactive waste sites at Hanford.** McLaughlin, T.J.; Carlile, J.M.V.; Cramer, K.H.; Hawley, K.A.; Lamar, D.A.; Sherwood, D.R.; Krupin, P.J. (Pacific Northwest Lab., Richland, WA 99352 (USA)). pp v of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—). Contract AC06-76RL01830.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

In July 1986, The U.S. Department of Energy - Richland Operations Office (DOE-RL) and Pacific Northwest Laboratory completed a preliminary assessment of 337 inactive waste sites that were used between 1943 and 1980 to dispose of liquid and solid wastes to the soil column of the Hanford Site. The study, as reported here and in a draft report, was performed as the first phase of DOE-RL's Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) program and will be used to determine which sites should be further investigated and possibly remediated. It should be noted that, because the report is not yet final, some of the results could change.

28920 **Some considerations in the evaluation of concrete as a structural material for alternative LLW disposal technologies.** MacKenzie, D.R.; Siskind, B.; Bowerman, B.S.; Piciulo, P.L. (Dept. of Nuclear Energy, Brookhaven National Lab., Upton, NY 11973 (USA)). pp v of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—).

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

The objective of this study was to develop information needed to evaluate the long-term performance of concrete and reinforced concrete as a structural material for alternative LLW disposal methods. The capability to carry out such an evaluation is required for licensing a site which employs one of these alternative methods. The basis for achieving the study objective was the review and analysis of the literature on concrete and its properties, particularly its durability. In carrying out this program characteristics of concrete useful in evaluating its performance and factors that can affect its performance were identified. The factors are both intrinsic, i.e., associated with composition of the concrete (and thus controllable), and extrinsic, i.e., due to external environmental forces such as climatic conditions and aggressive chemicals in the soil. The testing of concrete, using both accelerated tests and long-term non-accelerated tests, is discussed with special reference to its application to modeling of long-term performance prediction. On the basis of the study's results, conditions for acceptance are recommended as an aid in the licensing of disposal sites which make use of alternative methods.

28921 **Leaching of saltstone - laboratory and field testing and mathematical modeling.** Grant, M.W.; Langton, C.A.; Oblath, S.B.; Pepper, D.W.; Wallace, R.M.; Wilhite, E.L.; Yau, W.W.F. pp 278-282 of 194. National Meeting of American Chemical Society, Division of Environmental Chemistry. Washington, DC; American Chemical Society (1987). (CONF-870802—). Contract AC09-76SR00001.

From 194. American Chemical Society national meeting; New Orleans, LA, USA (30 Aug 1987).

A low-level alkaline salt solution will be a byproduct in the processing of high-level defense nuclear waste at the Savannah River Plant. This solution will be incorporated into a cement wasteform, saltstone, and disposed of in surface vaults. Laboratory and field leach testing and mathematical modeling have demonstrated the predictability of contaminant release from cement wasteforms. Saltstone disposal in surface vaults will meet the design objective which is to meet drinking water standards in shallow groundwater at the disposal area boundary.

28922 **Decontamination of low-level process effluents by reverse osmosis.** Ebra, M.A.; Piper, D.G.; Poy, F.L.; Siler, J.L. New York, NY; American Institute of Chemical Engineers (1987). 3p. (CONF-870822—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From American Institute of Chemical Engineers summer national meeting; Minneapolis, MN, USA (16 Aug 1987).

Technical Paper 43D.

A new facility is under construction at the Savannah River Plant to decontaminate process effluents containing low levels of radionuclides and hazardous chemicals prior to discharge to a surface stream. The facility is called the F/H Effluent Treatment Facility (F/H ETF). The effluentes are composed primarily of evaporator condensates which are currently discharged to seepage basins. The new facility will allow closure of the basins in order to meet the provisions of the Resource Conservation and Recovery Act. The 50 million dollar facility will contain advanced water treatment systems representative of the best currently available technology. The paper paper describes the facility and summarizes bench and pilot scale process development work that has been used to establish the design bases for the facility.

28923 **Optimization of NO/sub x/ and iodine removal in nuclear fuel reprocessing.** Weber, F.E.; Birdwell, J.F. New York, NY; American Institute of Chemical Engineers (1987). 25p. (CONF-870822—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From American Institute of Chemical Engineers summer national meeting; Minneapolis, MN, USA (16 Aug 1987).

Technical Paper 9D.

Removal of nitrogen oxides and fission product iodine from the offgas generated by dissolution is essential in the reprocessing of spent nuclear reactor fuel. The species NO, NO_2, N_2O_3, and N_2O_4 can account for as much as ten percent or the offgas generated by the dissolution of mixed oxide (Pu-O) fuels in nitric acid. While the radioisotopes of iodine are present in much smaller concentrations (only 15 grams are evolved in the dissolution of 500 Kg of 180-day cooled spent fuel), the radiological hazards it posses make the containment, partitioning, and disposal of iodine of paramount importance. A computer simulation which combines NO/sub x/ scrubbing with iodine liquidvapor partitioning and hydrolysis has been developed and used to evaluate a number of possible offgas system flowsheets. The conclusions reached using this simulation agree closely with experimentally obtained data. A generalized conclusion drawn from this study is that flowsheets which provide optimal processing of either NO/sub x/ or iodine do not provide optimal removal or both components. Therefore, compromises in flowsheet design must be made based on the operating parameters and offgas characteristics of each individual facility.

28924 **Remote removal of contaminated equipment from a radiochemical engineering cell.** Scharnhorst, N.L.; Bryan, G.H.; Bjorklund, W.J. pp 87-93 of Proceedings, 32nd conference on remote systems technology. Volume 2. Richland, WA; Pacific Northwest Laboratory (1984). Contract AC06-76RL01830.

Large-scale vitrification equipment in a radioactive cell was dismantled and packed for burial through the use of viewing windows with manipulators, two overhead cranes, and unique tools for disassembling, grabbing, and handling the equipment components. An air-driven reciprocating hacksaw, remotely placed and operated, was used to cut large structural members inaccessible by the manipulators. Remotely operated circular saws and a plasma torch were used to cut calciners, furnaces, storage vessels, piping, pumps, and structural members into pieces that were placed safely into shielded burial boxes. This engineering effort was accomplished without any exposure problems in approximately 17 months, which required almost 10 equivalent worker-years. 8 figures, 1 table.

28925 **Features of a radioactive liquid-fed ceramic melter system.** Holton, L.K. Jr.; Berger, D.N.; Bjorklund, W.J.; Dierks, R.D. pp 77-86 of Proceedings, 32nd conference on remote systems technology. Volume 1. Richland, WA; Pacific Northwest Laboratory (1984). Contract AC06-76RL01830.

Pacific Northwest Laboratory has remotely installed a Pilot-Scale Radioactive Liquid-Fed Ceramic Melter (RLFCM) System for conversion of high-level liquid wastes to borosilicate glass in shielded manipulator cells located at Hanford, Washington. The Pilot-Scale RLFCM System consists of a RLFCM, canister handling turntable, glass-level detection system and supporting waste

preparation, offgas treatment, and condensate treatment racks. The Pilot-Scale waste vitrification facilities, will be operated with radioactive wastes to test remote equipment features and process performance. Special devices were engineered to assist in remote installation, operation and maintenance of the equipment system. This paper discusses the remote features of this vitrification system. 11 figures.

0530 Environmental Aspects

REFER ALSO TO CITATION(S) 28887, 28891, 28892, 28893, 28899, 28900, 28903, 28904, 28906, 28907, 28908, 28909, 28910, 28911, 28915, 28916, 29445

0540 Health And Safety

REFER ALSO TO CITATION(S) 28922

0550 Safeguards, Inspection, And Accountability

REFER ALSO TO CITATION(S) 29149

28926 **(BNL—40221) Evaluation and control of inventory differences in the DOE complex.** Sanborn, J. (Brookhaven National Lab., Upton, NY (USA)). Aug 1987. Contract AC02-76CH00016. 47p. (TSO—87-9). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88007574/JAW.

Nuclear material accountancy serves two purposes as regards safeguards. First, it provides a capability for detecting the loss of nuclear material which is complementary to that provided by other security and material-control measures. Second, and equally important, it provides periodic reassurance to Congress and the public that material is actually under control by means of regular physical inventories. It is the only safeguards measure that provides direct evidence of the status of nuclear material. This report describes material accountancy in the Department of Energy (DOE) complex, causes of inventory differences and ID evaluation, and strategies for improving ID performance. 5 figs., 2 tabs. (CBS)

28927 **(UCRL—98091) SAFE{endash}The Security Awareness For Employees program:.** Parker, A. (Lawrence Livermore National Lab., CA (USA)). 29 Jan 1988. Contract W-7405-ENG-48. 4p. (CONF-880528—5).

From 35. annual international technical communication conference; Philadelphia, PA, USA (10 May 1988).

In the communications game, the players (communicators of all persuasions, "technical" and otherwise) strive to successfully deliver a predetermined message to a targeted audience. Whether the message involves understanding the construction of a computer or the convolutions of a benefits program, the basic game plan used to reach the goal is the same. This game plan can be defined in four steps. First, define the issue and the audience. Second, do background research and plan the program for reaching the target audience. Third, implement the program. Finally, evaluate the program's success and results. This process applies, whether the "program" consists of a single software manual or a full-blown multi-media extravaganza. SAFE - the Security Awareness For Employees program at Lawrence Livermore National Laboratory - is an example of this process in action in the employee communications arena.

0560 Legislation And Regulations

REFER ALSO TO CITATION(S) 28891, 28900, 28905

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0701 Physical Isotope Separation

28928 **(INIS-BR—1011) Radioisotope production.** Almeida, G.L. de. (Instituto de Engenharia Nuclear, Rio de Janeiro (Brazil)). 1987. 10p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702595/JAW.

The steps of Radioisotope Production Program using the cyclotron of the Nuclear Engineering Institute (IEN/CNEN), are presented. (M.C.K.).

0703 Isotopic Power Supplies

REFER ALSO TO CITATION(S) 29152

08 HYDROGEN

0801 Production

28929 **Thermochemical hydrogen production with the sulfur dioxide-iodine cycle by utilization of dipraseodymium dioxymonosulfate as a recycle reagent.** Onstott, E.I.; De Bruin, D. (Los Alamos National Lab., NM (USA); California Univ., Los Alamos (US)). *International Journal of Hydrogen Energy;* 13: No. 1, 1-6(1988).

Insoluble, dipraseodymium oxide-sulfite monosulfate hydrates were prepared by reaction of dipraseodymium dioxymonosulfate with sulfur dioxide in aqueous media at 340 K. These compositions reacted with iodine to yield sulfate in the solid phase and hydrogen iodide in the gas phase. High yields of hydrogen iodide were measured at 770 K for a reaction time of ten minutes. Yields also depended on the sulfite content of the hydrate compositions, and were highest when the dipraseodymium dioxymonosulfate was 60% neutralized with sulfurous acid. An increased yield of hydrogen iodide was obtained by a second iodine oxidation after separation of the first gaseous products. A water splitting thermochemical cycle utilizing these reactions is described in which hydrogen is produced by catalytic decomposition of hydrogen iodide, and oxygen results from thermal decomposition of the solid product, that also yields sulfur dioxide and dipraseodymium dioxymonosulfate for recycle.

09 OTHER SYNTHETIC AND NATURAL FUELS

0901 Hydrocarbon Fuels

REFER ALSO TO CITATION(S) 29329

28930 (PNL-SA—15482, pp 5-21) **Advanced extruder-feeder biomass liquefaction reactor system.** White, D.H.; Wolf, D.; Davenport, G.; Mathews, S.; Porter, M.; Zhao, Y. (Univ. of Arizona, Tucson (USA)). Nov 1987. NTIS, PC A09/MF A01. Order Number DE88006730/JAW. (CONF-8705212—).

From Conference on biomass thermochemical conversion contractors review meeting; Atlanta, GA, USA (20 May 1987).

Biomass including wood could provide liquid fuels on a regional basis if an economic liquefaction process can be developed. Through research sponsored by the US Department of Energy (DOE), under its Thermochemical Conversion Program managed by Battelle PNL, the University of Arizona has developed a unique

method of pumping concentrated, viscous biomass slurries, characteristic in biomass direct liquefaction systems. A modified single-screw extruder has now been shown to be capable of pumping solid slurries as high as 60 wt.% wood flour in wood oil derived vacuum bottoms, as compared to only 10-20 wt.% wood flour in wood oil in conventional systems. A Phase II program has integrated the extruder-feeder pumping system with a unique reactor which offers potential for further improving direct biomass liquefaction technology. An experimental facility was constructed during 1983-84, shakedown operations were conducted, and wood crude oil produced by Mid-1985. During the period August, 1985-April, 1987, a total of 18 experimental continuous biomass liquefaction runs were made using White Birch wood feedstock. Good operability with feed rates up to 30 lb/hr covering a range of carbon monoxide, sodium carbonate catalyst, pressures from 800 to 3000 psi and temperatures from 350°C to 430°C was achieved. Crude wood oils containing 6-10 wt.% residual oxygen were obtained. Other wood oil characteristics were reported.

28931 (PNL-SA—15482, pp 23-39) **Low pressure entrained flow pyrolysis of biomass to produce liquid fuels.** Kovac, R.J.; Gorton, C.W.; O'Neil, D.J.; Newman, C.J. (Georgia Technological Research Institute, Atlanta (USA)). Nov 1987. NTIS, PC A09/MF A01. Order Number DE88006730/JAW. (CONF-8705212—).

From Conference on biomass thermochemical conversion contractors review meeting; Atlanta, GA, USA (20 May 1987).

The continuing research effort on the entrained flow pyrolysis of hardwoods is discussed. This includes: a brief description of the entrained flow pyrolysis system and its operation, experimental progress since October, 1985 and an indication of the status of the modeling effort. The key component of the entrained pyrolysis system is the vertical pyrolysis reactor. The feed may be introduced at various locations providing for a maximum particle travel distance in the reactor of 23.7 feet. Hot combustion products convey the hardwood particles through the reactor. The pyrolysis vapors are condensed to form the liquid oil product. Six experimental runs have been made since October, 1985. Reactor exit temperatures ranged from 475°C to 525°C and the dry oil yields ranged from 43.4% to 53.8% based on moisture and ash free feed. Mass and energy balance closures ranged from 100.5% to 104.3% and 97.0% to 104.5%, respectively. Carbon recovery ranged from 96.1% to 98.9%. Modeling is an integral part of the research and the model is composed of coupled ordinary differential equations which are solved numerically via a computer code. A search routine is used with experimental data to obtain kinetic constants. Results from the modeling effort indicate that oil yields as high as 60% should be obtainable using the present pyrolysis system. Future modeling efforts will include the catalytic conversion of the pyrolysis oil product.

28932 (PNL-SA—15482, pp 41-60) **Molecular beam, mass spectroscopic studies of wood vapor and model compounds over HZSM-5 catalyst.** Evans, R.J.; Milne, T.A. (Solar Energy Research Institute, Golden, CO (USA)). Nov 1987. NTIS, PC A09/MF A01. Order Number DE88006730/JAW. (CONF-8705212—).

From Conference on biomass thermochemical conversion contractors review meeting; Atlanta, GA, USA (20 May 1987).

Molecular beam mass spectrometry has been used to characterize the direct conversion of biomass pyrolysis products over zeolites. This technique allows the observation of the reaction products in real time and is ideally suited to screen a variety of catalysts, operating conditions, and model compounds to determine relative reactivity and variation in product composition as a function of operating conditions. The products from Mobil's HZSM-5, Union Carbide's Silicalite, a wide-bore molecular sieve catalyst, and a silica/alumina catalyst were compared. This range of catalysts demonstrates the relative advantages of shape-selective catalysts with strong acid sites. The effect of temperature and weight hourly space velocity on product composition was screened and shows differences in reaction pathways between biomass pyrolysis products and methanol. The synergistic effect of co-feeding methanol and biomass was studied using this technique, and showed that less oxygen was rejected as water and more as carbon dioxide (preferable to conserve hydrogen) and more aromatic gasoline products were formed. Methods of calibration have been implemented so that yield estimates can be made. Replicate runs gave hydrocarbon yields from wood of 18 +/- 4 wt %, with equal amounts of light olefins and aromatics. Screening of model compounds has shown that the methoxyphenols derived from lignins give low yields of hydrocarbon products, while carbohydrate-derived ring structures, such as furfural and α-angelicalactones, are good sources of light aromatics.

28933 (PNL-SA—15482, pp 61-80) **Upgrading pyrolysis vapors to aromatic gasoline with zeolite catalysis at atmospheric pressure.** Diebold, J.; Scahill, J. (Solar Energy Research Institute, Golden, CO (USA)). Nov 1987. NTIS, PC A09/MF A01. Order Number DE88006730/JAW. (CONF-8705212—).

From Conference on biomass thermochemical conversion contractors review meeting; Atlanta, GA, USA (20 May 1987).

The primary pyrolysis vapors generated by the fast pyrolysis of biomass at atmospheric pressures consist initially of low-molecular-weight compounds but which polymerize upon condensation. Prior to condensation, these primary vapors have been found to be very reactive with ZSM-5 catalyst to produce methyl benzenes boiling in the gasoline range. This gasoline is predicted to have very high blending octane numbers. By-products are coke, carbon oxides, water, naphthalenes, ethylene, propylene, and some phenols. The effect of different by-products on the theoretical gasoline yield is examined. Preliminary results, generated with a reactor having a fixed bed of 100 g of catalyst, are examined for the continuous feeding of never-condensed primary vapors and compared to feeding methanol in the same reactor. The conversion of primary pyrolysis vapors made from biomass is a relatively new research and development area which is showing early promise. The extent to which the product slate can be manipulated by process variables will impact heavily on the viability of this process.

28934 (PNL-SA—15482, pp 81-97) **Research on hydrotreating catalysts to hydrodeoxygenate biocrude oils.** Elliott, D.C.; Baker, E.G. Nov 1987. NTIS, PC A09/MF A01. Order Number DE88006730/JAW. (CONF-8705212—).

From Conference on biomass thermochemical conversion contractors review meeting; Atlanta, GA, USA (20 May 1987).

Catalytic hydrotreating of wood-derived liquids is being studied using a continuous-feed, fixed-bed reactor. Commercial hydrotreating catalysts and conditions are used to hydrodeoxygenate and hydrocrack the biomass liquefaction products generated by high-pressure processing. Biomass flash pyrolyzates require alternate processing to first stabilize the products prior to catalytic hydrotreating. Experiments are performed in an upflow reactor wherein both liquid phase and gas-phase reactions are considered to be important. Although hydrocarbons are not produced in any significant amount by thermochemical direct liquefaction of wood, the use of a secondary hydrogenation step to treat the initial product can result in nearly pure hydrocarbons. These hydrocarbons are primarily cyclics and aromatics which would be useful in gasoline blending.

28935 (PNL-SA—15482, pp 99-113) **Low-temperature thermochemical conversion of high moisture biomass feedstocks.** Butner, R.S.; Elliott, D.C.; Sealock, L.J. Jr. Nov 1987. NTIS, PC A09/MF A01. Order Number DE88006730/JAW. (CONF-8705212—).

From Conference on biomass thermochemical conversion contractors review meeting; Atlanta, GA, USA (20 May 1987).

Pacific Northwest Laboratory has been developing a catalytic reactor for the thermochemical conversion of high moisture biomass feedstocks to higher-valued energy products, including high-Btu gas and liquid fuels. The high moisture feedstocks which have been tested include many underutilized materials such as energy crops, agricultural residues, and food processing solid wastes. This paper describes recent progress towards developing this technology, including modifications to the experimental system and procedures and the design of a continuously-fed reactor which is scheduled for construction during late FY87.

28936 (PNL-SA—15482, pp 115-139) **Technical and economic evaluation of emerging biomass pyrolysis processes for gasoline production.** Wan, E.I.; Fraser, M.D.; Kwarteng, I.K. (Science Applications International Corp., McLean, VA (USA)). Nov 1987. NTIS, PC A09/MF A01. Order Number DE88006730/JAW. (CONF-8705212—).

From Conference on biomass thermochemical conversion contractors review meeting; Atlanta, GA, USA (20 May 1987).

Recently emerging thermochemical processes may become viable methods of converting biomass feedstocks into high-value fuel products. In particular, innovative technologies may present new avenues for converting woody biomass into gasoline. This paper summarizes the technical and economic results of Science Applications International Corporation's (SAIC's) recent evaluation of two such advanced biomass-to-gasoline processes: (1) a fast pyrolysis process developed by the Georgia Institute of Technology, in which the wood pyrolyzate is upgraded via two-stage hydrotreating, and (2) the Solar Energy Research Institute flash ablative pyrolysis process, in which pyrolyzate vapors are upgraded via deoxygenation over zeolite catalysts. The purpose of this evaluation was to determine the economic bounds of these processes and the R & D required to develop them to their full economic potential. The results indicate that gasoline can be produced from a 1000-tpd future biomass conversion plant via Georgia Tech fast pyrolysis for about $0.86 to $1.07 per gallon of product at a potential yield of 91.6 gallons per ton (dry), and via SERI flash pyrolysis for about $0.94 to $1.13 per gallon at a yield of 65.5 gallons per ton (dry).

28937 (PNL-SA—15482, pp 141-150) **Bench-scale studies on fluid-bed pyrolysis of wood using different contact gases.** Mudge, L.K.; Brown, M.D.; Wilcox, W.A. Nov 1987. NTIS, PC A09/MF A01. Order Number DE88006730/JAW. (CONF-8705212—).

From Conference on biomass thermochemical conversion contractors review meeting; Atlanta, GA, USA (20 May 1987).

Results of bench-scale studies on fluid-bed pyrolysis of wood with carbon dioxide, methane, and hydrogen contact gases are described in this report. The primary objective of these studies was to determine the effect of thermal treatment with these gases on product yields, primarily yields and composition of condensible hydrocarbons. The effects of temperature, contact gas, wood feed rate, and gas contact time on the yields of gases, liquids and char are discussed. Yields of condensible hydrocarbons with different contact gases are compared to yields from steam pyrolysis of wood.

28938 (SERI/SP—231-3206, pp 27-42) **Collection, screening, and characterization of lipid producing microalgae: progress during fiscal year 1987.** Johansen, J.R.; Lemke, P.R.; Barclay, W.R.; Nagle, N.J. Sep 1987. NTIS, PC A12/MF A01. Order Number DE88001111/JAW.

In FY 1987 Aquatic Species Program: Annual report.

The collection, screening, and characterization of lipid producing microalgae has been an ongoing subprogram in the Aquatic Species Program since FY1983. Efforts in this subprogram at SERI have had three areas of emphasis during the past year: (1) characterization of warm-water strains; (2) initiation of a cold-water strains collection and screening project; and (3) development of a screening protocol to be used in reducing the number of strains in the Aquatic Species Program from 3000 to 200. Ten warm-water microalgae were characterized, seven of which were added to the Microalgae Culture Collection Catalogue (1986-1987). These strains were CHAET6, CHAET9, CHAET10, CHAET15, CHAET39, CYCL02, CYCL04, NAVIC1, PLEUR1, and THALA2. Of these, the Chaetoceros strains had the greatest tolerance for high salinity. CHAET9, CHAET10, and NAVIC1 are considered the best new strains of the ten characterized, and further study of these strains is underway. Cold-water strains were collected from the states of Washington, Utah, and California from shallow saline ponds during the fall (1986) and early spring (1987). They were screened at 15°C following the same enrichment protocol as that developed for warm-water strains. A total of 60 cold-water algae were isolated. A screening protocol was developed for rapidly reducing the number of microalgal strains in the program from 3000 to the best 200. This protocol will be used in characterization efforts at both SERI and Arizona State University, so that results obtained in both laboratories will be standardized and easily comparable. 26 references, 5 tables.

28939 (SERI/SP—231-3206, pp 43-57) **Screening microalgae isolated from the Southwest for growth potential and lipid yield.** Sommerfeld, M.R.; Ellingson, S.B.; Tyler, P.L. (Arizona State Univ., Tempe (USA)). Sep 1987. NTIS, PC A12/MF A01. Order Number DE88001111/JAW.

In FY 1987 Aquatic Species Program: Annual report.

To enlarge the pool of algal species that have a propensity to grow rapidly, store lipids and be suitable for mass cultures in saline waters, a total of 125 aquatic sites in Arizona, California, Nevada, New Mexico, Texas and Utah were sampled that varied widely in temperature, pH, salinity and relative ionic composition. From the approximately 1700 isolations made approximately 700 unialgal cultures of microalgae have been established. Growth rate determination have been made on 131 isolates using the SERI Type I and II Media at various salinities and temperatures. Forty-nine strains, primarily diatoms and chlorophytes, demonstrated growth rates exceeding one doubling per day and five exceeded two doublings per day. Preliminary growth optimization efforts with 15 of the algal strains indicate that the most rapid growth occurs when isolates are cultured with urea as the nitrogen source at 25°C under 500 uE/m²/sec of light. For many of the strains, altering the nitrogen source and elevation of light intensity from 25 to 50 uE/m²/sec had relatively little affect on growth rate. The fluorescent dye, Nile Red, was used to microscopically screen for intracellular lipid storage. Using fluorometric quantification seven microalgal cultures yielded more than 200 mg/l and four yielded greater than 400 mg/l triolein equivalent lipids. 16 references, 7 figures, 3 tables.

28940 (SERI/SP—231-3206, pp 58-74) **Conclusion on the warm-water algae collection and screening efforts conducted in the southeastern United States.** Tadros, M.G. (Alabama A & M Univ., Normal (USA)). Sep 1987. NTIS, PC A12/MF A01. Order Number DE88001111/JAW.

In FY 1987 Aquatic Species Program: Annual report.

In the third year of this project, one collection trip was made to the intertidal region and near islands along coasts of Florida, Alabama, and Mississippi. Among 63 algal strains isolated, five fast growers and lipid accumulators were characterized; Nitzschia dissipata (307), Navicula sp. (324), Navicula acceptat (304), Amphipropra hyalina (333), and Chaetoceros sp. (330). N. dissipata culture limited in nitrogen and silicon, showed 45.9%, 47.2% lipids. Navicula sp. (324) and N. acceptata cultures limited in nitrogen and silicon exhibited accumulated lipids, 39.6%, 47.2% and 38.2%, 42.5%, respectively. Two exceptional diatoms were A. hyalina and Chaetoceros sp. (330). Under nitrogen and silicon limited culture conditions, A. hyalina accumulated 30.2%, 37.1% lipids and 42.0%, 34.4% carbohydrates, respectively, while Chaetoceros 330 accumulated 28.7%, 22.2% lipids and 24.6%, 30.3% proteins. 8 references, 8 figures, 3 tables.

28941 (SERI/SP—231-3206, pp 75) **Lipogenic picoplekton.** Cheng, L.; Lewin, R.A. (Univ. of California, San Diego (USA)). Sep 1987. NTIS, PC A12/MF A01. Order Number DE88001111/JAW.

In FY 1987 Aquatic Species Program: Annual report.

The authors have been studying the production of lipids in 10 selected strains of small marine unicellular algae which exhibit tendencies to float. During the past three years they collected approximately 300 samples of surface sea-water, primarily from inshore locations. After a simple enrichment procedure, 80 different strains (clones) were isolated, first in crude and eventually in pure, axenic culture. All were tested for their salinity and temperature ranges for growth, and for their requirements for exogenous vitamins. In appropriate conditions - culture medium, light, temperature, etc. - samples were grown and prepared for preliminary lipid analyses. The authors obtained determinations for species in the following categories (the taxonomy must be regarded as provisional): Nannochloris (Chlorophyta) - 34 clones; Stichococcus (Chlorophyta) - 24 clones; Chlorella (Chlorophyta) - 16 clones; and Eustigmatophyta - 14 clones. In addition, a number of diatoms were isolated, which were transferred to SERI for further study. The authors selected ten strains that showed promise for high lipid production and studied their physiology. They grow well under continuous illumination (150-200 Alb) at 20-25°C, and under these conditions growth rates and lipid yields were compared.

28942 (SERI/SP—231-3206, pp 76) **Collection of high energy strains of saline microalgae from the Hawaiian Islands.** York, R.H. Jr. (Hawaii Institute of Marine Biology, Kaneohe (USA)). Sep 1987. NTIS, PC A12/MF A01. Order Number DE88001111/JAW.

In FY 1987 Aquatic Species Program: Annual report.

Clones of microalgae isolated from the Hawaiian Islands were tested for production under conditions similar to those expected in large-scale culture facilities. An air-conditioned, full-spectrum solarium was used to control environmental conditions. Cultures, 10 liters in volume and 15 cm deep, were rolled by aeration from diffusers through which CO_2 gas was also added using pH controllers. Growth and production responses to culture density, dissolved oxygen concentration, pH, salinity, solar irradiance, temperature, and water type were determined for the most productive clones. The effect of solar ultraviolet irradiance on lipid production was investigated. The most productive clones were diatoms in the genera Chaetoceros, Cyclotella, and Nitzschia. These were isolated from shallow, eutrophic, saline ponds.

28943 (SERI/SP—231-3206, pp 77-91) **Effects of fluctuating environments on the selection of high yielding microalgae.** Benemann, J.R.; Tillett, D.M. (Georgia Institute of Technology, Atlanta (USA)). Sep 1987. NTIS, PC A12/MF A01. Order Number DE88001111/JAW.

In FY 1987 Aquatic Species Program: Annual report.

The mass culture of microalgae for low cost oils production requires a detailed understanding of the physiology of lipid biosynthesis by the selected algal strains and of the factors making these strains competitive in outdoor ponds. Mass-culture systems will exhibit diurnal and seasonal fluctuations in key parameters affecting algal productivity and dominance: temperature, pH, pO_2, pCO_2, light, and nutrient availability. The overall objective of this project is to quantitate the effects of such fluctuations on productivity and species dominance and to identify microalgal species suitable for mass culture. Using Nanno Q (Nannochloropsis sp.) as a test organism the authors investigated strategies for maximizing lipid productivity. The data suggest a two stage process: the first stage is operated under light limitations and nitrogen sufficiency at the standing biomass permitting maximal productivity and the second stage under dual light and nitrogen limitations at a lower standing biomass (e.g. higher per cell light input). In species competition experiments with several strains of algae, certain parameters were more important than others in affecting species dominance: a diurnal cycle of high pO_2 was more important than fluctuating temperature, which was more important than fluctuating pH. These results are being extended to other species and conditions using both unialgal and multiple species cultures. The objective is to demonstrate that species competitiveness can be predicted from the productivity of unialgal cultures and to develop a protocol for the efficient screening of species potentially useful in outdoor pond systems. To help guide this work, a computer model was developed capable of predicting average diurnal and seasonal variations in pond environmental parameters (pO_2, pH, pCO_2, temperature).

28944 (SERI/SP—231-3206, pp 92-107) **Nutritional requirements for maximal growth of oil producing microalgae.** Rhyne, C.F. (Jackson State Univ., MS (USA)). Sep 1987. NTIS, PC A12/MF A01. Order Number DE88001111/JAW.

In FY 1987 Aquatic Species Program: Annual report.

The purpose of this study was to define the nutritional requirements for selected known oil-producing microalgae originally from marine and inland saline habitats. Species tested were SERI collections of the diatoms Chaetoceros 9, Chaetoceros 10, Chaetoceros 15, Navicula 2, Thalassiosira 2 and the green algal Monoraphidium 2. A protocol for culturing and quantifying growth as doublings/day was established using culture tubes on shakers. Culture tubes served as spectrophotometric cuvettes and were read every 24 hours over a 5-day period. Nitrogen as NO_3, NH_4 and urea were tested for preference and optimal concentrations. Phosphate-P, Si (for diatoms) and the trace metal Fe were also tested for optimal concentrations. Three species, Chaetoceros 10, Navicula 2 and Monoraphidium 2 showed significantly higher doublings times in NO_3-N as opposed to both NH_4-N and urea-N. Thalassiosira 2 showed good growth at very low concentrations of urea-N. Thalassiosira and Chaetoceros 9 demonstrated very good growth at low concentrations of phosphorous. Chaetoceros 9 demonstrated significantly higher growth when $FeCl_3$ was replaced with $FeNH_4$-citrate. Of the two species tested, Chaetoceros 9 required vitamin B_{12} and Monoraphidium 2 required thiamine. This information should contribute to the SERI Aquatic Species Program and others as a guide toward optimizing growth prior to the shift toward lipid production. 28 references, 7 figures, 4 tables.

28945 (SERI/SP—231-3206, pp 108-126) **Effects of nutrients and temperature on lipid production and fatty acid composition in Monoraphidium minitum and Cyclotella DI-35.** Sriharan, S.; Bagga, D.; Sriharan, T.P.; Das, M. (Selma Univ., AL (USA)). Sep 1987. NTIS, PC A12/MF A01. Order Number DE88001111/JAW.

In FY 1987 Aquatic Species Program: Annual report.

The diatoms, Monoraphidium minitum and Cyclotella DI-35 were batch cultured in Nitrogen (N) concentrations as Nitrogen-sufficient (NS) and Nitrogen-deficient (ND); in Silica (S) concentrations as Silica-sufficient (SS) and Silica-deficient (SD) media. The treatments were maintained at 30°C and 20°C under continuous illumination. The growth of these diatoms was evaluated by measuring the optical density. The biomass was harvested, the amounts of ash-free dry weight and total lipids were determined by gravimetric method. The total lipids were analyzed for neutral lipids and polar lipids. The fatty acids were measured by direct transesterification method followed by gas chromatography and mass spectrometry. The growth response was significantly higher in NS and SS media than in ND and SD media of both Monoraphidium minitum and Cyclotella DI-35. The lipid production in general was greater in nitrogen as well as silica deficient media in these diatoms. The amounts of total lipids, neutral lipids and polar lipids were higher in ND and SD treatments at 30°C and 20°C. The effects of nitrogen and silica stress in growth media were observed on distribution of fatty acids in Monoraphidium minitum and Cyclotella DI-35. Both qualitative and quantitative changes were noted in fatty acids. 30 references, 2 figures, 6 tables.

28946 (SERI/SP—231-3206, pp 129-141) **Effect of environmental parameters on lipid production in Navicula saprophila.** Chelf, P.; Barclay, B.; Lemke, P. Sep 1987. NTIS, PC A12/MF A01. Order Number DE88001111/JAW.

In FY 1987 Aquatic Species Program: Annual report.

A set of full and fractional factorial experiments was performed to develop a model to predict the effects of environmental parameters on lipid production in Navicula saprophila. Factors examined included nitrogen concentration, silicon concentration, temperature, time, conductivity, and alkalinity. Measured characteristics included nile red fluorescence (as a measure of neutral lipid content) and ash-free dry weight. The multiple regression model developed from a Box-Behnken design for the ratio of nile red fluorescence to ash-free dry weight had an R_3 of 89.34%, and included five main effects, five two factor interaction terms, and two squared terms. The most important variables in this regression model were nitrogen concentration and conductivity. The validity and potential use of models such as this one are discussed. 19 references, 5 figures, 4 tables.

28947 (SERI/SP—231-3206, pp 142-154) **Improvement of microalgal strains for lipid production.** Solomon, J.A.; Palumbo, A.V. (Oak Ridge National Lab., TN (USA)). Sep 1987. NTIS, PC A12/MF A01. Order Number DE88001111/JAW.

In FY 1987 Aquatic Species Program: Annual report.

Strategies were devised to allow for the selection of high-lipid cells using flow cytometry, from microalgal populations in exponential or stationary growth phase. Earlier results had indicated that cells could be sorted with a flow cytometer on the basis of their lipid content after being stained with a fluorescent dye that is specific for neutral lipids. However, the resulting cultures often did not have higher lipid content than the parent cultures when measured many generations after the sort. Recent results suggest that when cell cycle differences in the parent culture are taken into account, high-lipid daughter populations, can retain their enhanced lipid levels for many generations. When the lipid level was used as the sole criterion for sorting, the sorts were successful, resulting in high-lipid daughter populations, if they took place after the cells

had stopped dividing; but they were not successful if cultures were sorted while growing exponentially. Apparently, sorting exponentially growing cultures by lipid content alone selects for cells which are high in lipid primarily because they are about to divide. Exponentially growing populations were sorted successfully when the chlorophyll:lipid ratio was used for defining the sorting window. This procedure results in selection of cells at all stages in the cell cycle and yields cells which are higher in lipid content than the average cell at that growth stage.

28948 (SERI/SP—231-3206, pp 159-173) **Effects of silicon deficiency on several enzymes involved in lipid and carbohydrate biosynthesis in Cyclotella cryptica.** Roessler, P.G. Sep 1987. NTIS, PC A12/MF A01. Order Number DE88001111/JAW.

In FY 1987 Aquatic Species Program: Annual report.

Previous studies with the diatom C. cryptica have indicated that Si deficiency induces an increase in the fraction of newly assimilated carbon that is partitioned into lipids and a decrease in the fraction that is partitioned into storage carbohydrate (chrysolaminarin). The results are summarized of research that was designed to increase knowledge concerning the enzymatic basis for this change in carbon partitioning. Initial studies focused on the enzymology of chrysolaminarin biosynthesis. In vitro experiments provided evidence that chrysolaminarin is synthesized via the action of two enzymes: (1) UDPglucose pyrophosphorylase, and (2) chrysolaminarin synthase (UDPglucose:β-(1 $\rightarrow$ 3)-glucan β-3-glucosyl transferase). The specific activity (1) in extracts of C. cryptica cells was not affected after four hours of Si deficiency, but the activity of chrysolaminarin synthase decreased by 31% during this time period. The enzymology of lipid synthesis in C. cryptica was also investigated. Acetyl-CoA hydrolase, acetyl-CoA synthetase, and acetyl-CoA carboxylase (aCc) were present in cell-free extracts, but citrate lyase activity was not detected. The specific activity of aCc (which is believed to be the rate-limiting enzyme of fatty acid biosynthesis) increased approximately two-fold after four hours of Si deficiency, but this induction could be blocked by cycloheximide (an inhibitor of protein synthesis) and actinomycin D (an inhibitor of gene transcription). The results of these enzymatic analyses suggest that the increased allocation of newly assimilated carbon into lipids in Si deficient C. cryptica cells is probably due in part to a reduction in the activity of chrysolaminarin synthase along with a concomitant increase in the activity of aCc.

28949 (SERI/SP—231-3206, pp 174-189) **Biochemical elucidation of neutral lipid synthesis in microalgae: report of a mechanism to induce neutral lipid accumulation and implications for increasing neutral lipid yields from microalgae.** Guckert, J.B.; Cooksey, K.E.; Jackson, L.L. (Montana State Univ., Bozeman (USA)). Sep 1987. NTIS, PC A12/MF A01. Order Number DE88001111/JAW.

In FY 1987 Aquatic Species Program: Annual report.

Initial steps were taken to determine the contribution of neutral lipid (NL) synthesis to NL accumulation. Beginning work concerned the development of analytical methods including the modification of commercially-available equipment to achieve better resolution of fatty acids labelled from 14-C acetate. In carrying out this work, the authors have also compared various lipid extraction systems and developed a larger scale laboratory growth system for microalgae. Experiments involving maintenance of pH in the growth media indicated that manipulation of this parameter in conjunction with inorganic carbon concentration leads to a true increase in NL accumulation in Chlorella at non-limiting nitrate concentrations. These experiments provide evidence of a more universal mode of action of so-called NL triggers which can be exploited in the laboratory and perhaps, in a production setting. Various nutrient deprivation regimes may all have their effects on NL accumulation by disrupting the cell cycle. The authors shall exploit this hypothesis in future work. 29 references.

28950 (SERI/SP—231-3206, pp 190-206) **Environmental control of lipid accumulation in Nannochloropsis salina, Nanno Q, and Euglena.** Coleman, L.; Rosen, B.; Schwartzbach, S.D. (Univ. of Nebraska, Lincoln (USA)). Sep 1987. NTIS, PC A12/MF A01. Order Number DE88001111/JAW.

In FY 1987 Aquatic Species Program: Annual report.

Lipid per cell of photosynthetic Nanno Q, Nannochloropsis salina and Euglena increased during nitrogen deficiency and decreased upon the addition of a utilizable nitrogen source. In Nanno Q and Euglena, the increase in cellular lipid was not associated with an increase in lipid as a fraction of cellular dry weight. In Nannochloropsis salina, lipid transiently increased from 26-32% to 42% of ash free dry weight during nitrogen deficiency. Under anaerobiosis, lipid increased from 7% to 45% of the cellular dry weight of heterotrophic nitrogen deficient Euglena. This increase was due as much to a decrease in cellular dry weight as it was to a preferential utilization of available carbon for lipid synthesis. Nitrogen deficient and sufficient cultures of heterotrophic Euglena produce an equal amount of lipid per mole of available carbon. Nitrogen deficiency inhibits cell division so that this lipid is divided among fewer cells resulting in a higher amount of lipid per cell. Nitrogen deficiency induces chlorophyll loss in all algae studied. In Euglena, chlorophyll loss was seen only at high light intensities. An analysis of total cellular protein by two dimensional gel electrophoresis indicated that chloroplast proteins are preferentially lost during nitrogen deficiency. The dependence in nitrogen deficient cells of chlorophyll and chloroplast protein loss on high light intensities is consistent with photooxidative damage to the chloroplast. Based on the studies with heterotrophic and photosynthetic Euglena, it appears that photooxidative damage to the chloroplast may be a major factor limiting photosynthetic lipid yields in nitrogen deficient cells. 21 references.

28951 (SERI/SP—231-3206, pp 255-263) **Conversion of lipids through biological pretreatment.** Nagle, N.; Chelf, P.; Lemke, P.; Barclay, B. Sep 1987. NTIS, PC A12/MF A01. Order Number DE88001111/JAW.

In FY 1987 Aquatic Species Program: Annual report.

An important step in the utilization of lipids produced by microalgae will be the conversion of algal lipids into usable fuel stocks. The first step in the process is the conversion of triglycerides into free fatty acids for transesterification. A naturally occurring enzymatic process which accomplishes this conversion, was observed, and investigated. Promising species of lipid producing microalgae were screened for the presence of this enzymatic activity. A regression model was developed to predict the effects of important variables on this process. Results indicate that silica concentration and temperature important variables that control the conversion of triglycerides into free fatty acids.

28952 (SERI/SP—231-3206, pp 264-265) **Catalytic upgrading of whole algae and their components with shape-selective zeolites.** Milne, T.A.; Evans, R.J. Sep 1987. NTIS, PC A12/MF A01. Order Number DE88001111/JAW.

In FY 1987 Aquatic Species Program: Annual report.

Exploratory studies are being carried out of the pyrolysis of whole algae and their major components, supplied by SERI's Biotechnology Research Branch. A conversion process that made use of all parts of the microalgae to produce a single, high-octane liquid transportation fuel, has the potential for a simplified flowsheet, higher yields, eased restrictions on the trade-off between total growth and lipid yields, greater insensitivity to the type of lipid formed, and a single, transportable product to market. It is expected that polar lipids and hydrocarbons, as well as triacylglycerols, will all give substantial yields of gasoline. The use of the SERI molecular-beam, mass-spectrometric pyrolysis sampling system is described and initial results are presented for the conversion of extracted lipids, whole algae, and the whole algal residue after lipid extraction. This system has the advantage that only a few hundred milligrams of material are needed to screen for relative gasoline yields from experimental algae and their components. In addition, pyrolysis fingerprints of the algal material before catalysis will be shown to illustrate the possible use of this information for rapid estimates of major lipid components. In a more extensive program, the authors would wish to examine the quantitative yields; the synergistic effects of co-converting carbohydrates, proteins, and lipids; the fate of nitrogen, which may evolve as ammonia; the yield of CO_2, which may be concentrated enough to be recycled into the microalgae production facility; and the amount of water that can be tolerated in the algae as they are fed to the pyrolysis/catalysis unit. The knowledge of these parameters would allow the preliminary evaluation of the economics of this conversion scheme.

0902 Alcohol Fuels

REFER ALSO TO CITATION(S) 28803, 28804, 28823, 29310

28953 **(BNL—40685) Update of low temperature catalyst development.** Mahajan, D.; Sapienza, R.S.; O'Hare, T.E.; Skaperdas, G.T. (Brookhaven National Lab., Upton, NY (USA)). May 1987. Contract AC02-76CH00016. 15p. (CONF-8705261—1). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88007032/JAW.

From 12. annual EPRI contractors' conference on fuel science and conversion; Palo Alto, CA, USA (13 May 1987).

A highly active catalyst system for the synthesis of methanol from synthesis gas has been under development at BNL. A combination of low temperature (≧70/sup {degree/}C), low pressure (≧ 100 psi), and liquid phase performance makes it possible to achieve high conversion per pass, typically >90% with feed gas composed of hydrogen to carbon monoxide ratio of 2 with this new catalyst. High selectivity to methanol (>95%) has been routinely achieved with methyl formate, a value added product, being the by-product. In addition to temperature and pressure, activity of the new catalyst is sensitive to catalyst formulation, solvent medium, and concentration of product methanol. The catalyst is inert to most impurities normally present in coal-derived syngas, although the carbon dioxide to carbon monoxide ratio is a critical factor. 6 refs., 5 figs., 2 tabs.

28954 **Intracellular accumulation of AMP as a cause for the decline in rate of ethanol production by Saccharomyces cerevisiae during batch fermentation.** Dombek, K.M.; Ingram, L.O. (Univ. of Florida, Gainesville). *Applied and Environmental Microbiology;* **54**: No. 1, 98-104(Jan 1988).

A general hypothesis is presented for the decline in the rate of ethanol production (per unit of cell protein) during batch fermentation. Inhibition of ethanol production is proposed to result from the intracellular accumulation of AMP during the transition from growth to the stationary phase. AMP acts as a competitive inhibitor of hexokinase with respect to ATP. When assayed in vitro in the presence of ATP and AMP concentration equivalent to those within cells at different stages of fermentation, hexokinase activity declined in parallel with the in vivo decline in the rate of ethanol production. The coupling of glycolytic flux and fermentation to cell growth via degradation products of RNA may be of evolutionary advantage for Saccharomyces cerevisiae. Such a coupling would reduce the exposure of nongrowing cells to potentially harmful concentrations of waste products from metabolism and would conserve nutrients for future growth under more favorable conditions.

0903 Inorganic Hydrogen Compound Fuels

28955 **Ammonia synthesis over rhenium single-crystal catalysts: kinetics, structure sensitivity, and effect of potassium and oxygen.** Asscher, M.; Carrazza, J.; Khan, M.M.; Lewis, K.B.; Somorjai, G.A. (Lawrence Berkeley Lab., CA (USA)). *Journal of Catalysis;* **98**: No. 2, 277-287(Apr 1986). Contract AC03-76SF00098.

The ammonia synthesis from nitrogen and hydrogen has been investigated over model single-crystal and polycrystalline foil rhenium catalysts at 20 atm reactant pressure and in the temperature range 720-900 K. The reaction rate is remarkably sensitive to the catalyst surface structure. A reactivity ratio of 1:94:920:2820 was found for the Re(0001), Re(1010), Re(1120), and Re(1121) crystal faces, respectively. The catalytic activity of rhenium for ammonia synthesis is higher the more open and rough the surface is. An apparent activation energy of 19.4 +/- 1.1 kcal/mol was observed, regardless, of the catalyst surface structure. Kinetic data, reactant pressure dependence, and deuterium isotope effect indicate that, as in the case of iron, the rate-determining step is the dissociative chemisorption of the nitrogen molecule. Potassium metal adsorbed on the clean rhenium surface does not have any effect on the reaction rate. The coadsorption of potassium with oxygen does not suppress the reactivity of the catalyst and stabilization of potassium on the surface occurs. 27 references.

0904 Solid Waste And Wood Fuels

REFER ALSO TO CITATION(S) 28842

28956 (PNL-SA—15482, pp 151-169) **Evaluation of manure as a feedstock for gas turbines.** Hamrick, J.T. (Aerospace Research Corp., Roanoke, VA (USA)). Nov 1987. NTIS, PC A09/MF A01. Order Number DE88006730/JAW. (CONF-8705212—).

From Conference on biomass thermochemical conversion contractors review meeting; Atlanta, GA, USA (20 May 1987).

A preliminary program on evaluation of feedlot manure as a feedstock for gas turbines has been completed. It was determined that manure can be pulverized and fed into a gas turbine combustion system with the manure burning in much the same manner as a liquid or gaseous fuel. Ash and dirt in the manure did not appear to have a significant effect on combustion and were effectively removed by the cyclone filters. The exhaust gases varied from clear to a blue haze. Severe problems were encountered with slagging of the hot refractory walls of the combustor. Development of a suitable combustor will be required before a commercial size system can be designed.

28957 (PNL-SA—15482, pp 171-182) **3 MW wood fired gas turbine at Red Boiling Springs, Tennessee.** Hamrick, J.T. (Aerospace Research Corp., Roanoke, VA (USA)). Nov 1987. NTIS, PC A09/MF A01. Order Number DE88006730/JAW. (CONF-8705212—).

From Conference on biomass thermochemical conversion contractors review meeting; Atlanta, GA, USA (20 May 1987).

Operation of the 3000 kw system at Red Boiling Springs, Tennessee has produced valuable information about operation with wood and limitations as to operating temperatures. Emission measurements and analyses by the Battelle Columbus Division show that no significant problems exist with emission from the system. After running for 481 hours, 62 1/2 of which were generating power, no turbine erosion has been detected. The major long term problem involves periodic cleaning of deposits from the turbine stators and blades, a problem that is manageable for operation at turbine inlet temperatures at or below 1450°F. A description of the T-56 engine, how it was adapted for wood burning and a brief review of operating experience are presented. Included are start up and shut down procedures, the effects of pressure differential on internal leakage at critical points in the system, feeding of the wood, and turbine blade cleaning.

13 HYDRO ENERGY

1306 Environmental Aspects

28958 **Assessing flushing-flow requirements for brown trout spawning gravels in steep streams.** Kondolf, G.M.; Cada, G.F.; Sale, M.J. (Johns Hopkins Univ., Baltimore, MD). *Water Resources Bulletin;* **23**: No. 4, 927-935(Aug 1987). Contract AC05-84OR21400.

Flushing flows are releases from dams designed to remove fine sediment from downstream spawning habitat. We evaluated flushing flows on reaches proposed for hydroelectric diversions on seven streams in the eastern Sierra Nevada, California, with wild populations of brown trout (Salmo trutta). The stream reaches are steep, are dominated by boulder cascades, and afford few opportunities for gravel deposition. Methods for estimating flushing flows from flow records, developed from studies in other localities, produced widely differing results when applied to the study streams, probably reflecting differences in the hydrologic and geomorphic characteristics of the streams on which the methods were developed. Tracer gravel experiments demonstrated that all sampled gravels were washed out by the flows of 1986, a wet year. Size analyses of gravel samples and hydraulic data from field surveys were used in tractive-force calculations in an attempt to specify the flow required to flush the gravels. However, these calculations produced some unrealistic results because the flows were nonuniform in the study reaches. This suggests that the tractive-force approach

may not be generally applicable to small, steep streams where non-uniform flow conditions prevail.

1307 Power-conversion Systems

28959 **(DOE/ID—10190) Analysis of the Idaho Falls City Plant turbine failure.** Chappell, J.R.;Gendron, M.;Hood, D.W.;Rinehart, B.N.;Sommers, G.L.;Spaletta, H.W. (Idaho National Engineering Lab., Idaho Falls (USA)). Feb 1987. Contract AC07-76ID01570. 52p. NTIS, PC A04; GPO Dep. Order Number DE88008227/JAW.

The Idaho Falls City Hydroelectric Plant tripped off of the power grid during an electrical storm on September 23, 1986. Operators attempted to restart the plant but could not get it up to speed and synchronized. When the turbine was disassembled, a trunnion arm on one of the blades was broken, damage was found on the blade tips, blade thrust bearings and blade radial bearings and the turbine lubricating oil was visibly contaminated with metal particles. Meetings were held at the plant with representatives of the city, Idaho Operations Office of DOE, Bonneville Power Administration (BPA), EG & G Hydropower group and Idaho Laboratory Facility (ILF) in attendance. Possible causes of the problem were postulated and several scenarios discussed weighing the evidence but no primary cause for the failure was evident. It was decided to perform limited laboratory examinations of the damaged components at the INEL facilities.

14 SOLAR ENERGY

1404 Environmental, Legal, And Institutional Aspects

REFER ALSO TO CITATION(S) 29449

1405 Solar Energy Conversion

REFER ALSO TO CITATION(S) 28930, 28931, 28932, 28933, 28934, 28935, 28936, 28937, 28938, 28939, 28940, 28941, 28942, 28943, 28944, 28945, 28946, 28947, 28948, 28949, 28950, 28951, 28952, 28954, 28956, 28957, 29449, 29460, 29468, 29469, 29484

28960 (SERI/SP—231-3206, pp 231-252) **Design and operation of an outdoor microalgae test facility.** Weissman, J.C.; Tillet, D.M.; Goebel, R.P. (Microbial Products, Inc., Fairfield, CA (USA)). Sep 1987. NTIS, PC A12/MF A01. Order Number DE88001111/JAW.

In FY 1987 Aquatic Species Program: Annual report.

The objective of this project is to establish and operate a facility in the American Southwest to test the concept of producing microalgal biomass as a feedstock for the production of liquid fuels. The site chosen for this is located in the city of Roswell in southeastern New Mexico at an existing water research station. The climate and water resources are described. During the first year, a small scale system consisting of six 3 m^2 fiberglass raceways was constructed and operated to evaluate the performance of algal species in terms of productivity and lipid content. The ease of operating and the low cost of constructing several of these small cultivation units makes them ideal for performing controlled, replicated experiments. The research plan for the initial period of operation is presented. Since the ultimate goal of the Aquatic Species Program requires the production of large amounts of biomass, larger scale research systems are needed. Two larger raceways, each 0.1 hectare were designed and are under construction. These will be used to evaluate the performance of low cost lining options relative to durable, expensive plastic membranes. Other scale-up problems will also be addressed in these and in a 0.5 hectare demonstration raceway to be built in a subsequent year.

28961 (SERI/SP—231-3206, pp 269) **CO_2 sources for fuel synthesis.** Karpuk, M.E. (Technology Development Associates, Golden, CO (USA)). Sep 1987. NTIS, PC A12/MF A01. Order Number DE88001111/JAW.

In FY 1987 Aquatic Species Program: Annual report.

Efficient production of liquid fuels from microalgae will require large quantities of CO_2 at low cost. In this recently initiated study, the author examines both current commercial and possible new sources of CO_2 and evaluates their potential to supply the quantities of CO_2 required for large scale microalgae production. Current commercial sources of CO_2 include concentrated waste streams such as from fermentation plants and natural gas processing plants and natural reservoirs of nearly pure CO_2. Possible new sources include flue gas, advanced power plants and air separation in addition, the author evaluates CO_2 transportation costs, the energy requirements and costs of CO_2 separation processes, and the impact of potential regulations to control CO_2 emissions from fossil fuel power plants.

28962 **Light soaking behavior of a-Si:H p-i-n solar cells.** Tsuo, Y.S.;Xi, J.P.;McMahon, T.J. (Solar Energy Research Institute, Golden, Colorado, U.S.A.). *AIP (American Institute of Physics) Conference Proceedings;* **157**: No. 1, 165-170(25 Jun 1987). (CONF-870116—). Contract AC02-83CH10093.

From International conference on stability of amorphous silicon alloy materials and devices; Palo Alto, CA, USA (28 Jan 1987).

We have studied the effects of light soaking on p-i-n a-Si:H solar cells. We find that degradation is much greater when light soaking and cell measurements are both done through the n-layer rather than through the p-layer. A slight increase in the short-circuit current was observed whenever a sample soaked with blue or white light through the p-layer was also measured through the p-layer. The relative increase of the short-circuit current is greater with larger i-layer thicknesses.

1408 Ocean Energy Systems

28963 **Heat transfer research for ocean thermal energy conversion.** Kreith, F.;Bharathan, D. (University of Colorado, Boulder, CO 80309). *Journal of Heat Transfer;* **110**: No. 1, 5-22(Feb 1988).

In this lecture an overview of the heat and mass-transfer phenomena of importance in ocean thermal energy conversion (OTEC) is presented with particular emphasis on open-cycle OTEC systems. Also included is a short historical review of OTEC developments in the past century and a comparison of open and closed-cycle thermodynamics. Finally, results of system analyses, showing the effect of plant size on cost and the near-term potential of using OTEC for combined power production and desalination systems, are briefly discussed.

1410 Solar Collectors And Concentrators

28964 **(N—88-18068) Solar concentrator advanced development program, task 1. Final report.** (Harris Corp., Melbourne, FL (USA)). Jun 1986. 223p. (NASA-CR—179489; NAS—1.26:179489). NTIS, PC A10/MF A01.

Solar dynamic power generation has been selected by NASA to provide power for the space station. Solar dynamic concentrator technology has been demonstrated for terrestrial applications but has not been developed for space applications. The object of the Solar Concentrator Advanced Development program is to develop the technology of solar concentrators which would be used on the space station. The first task of this program was to develop conceptual concentrator designs and perform trade-off studies and to develop a materials data base and perform material selection. Three unique concentrator concepts; Truss Hex, Spline Radial Panel and Domed Fresnel, were developed and evaluated against weighted trade criteria. The Truss Hex concept was recommended for the space station. Materials data base development demonstrated that several material systems are capable of withstanding extended periods of atomic oxygen exposure without undesirable performance degradation. Descriptions of the conceptual designs and materials test data are included.

28965 **(PB—88-173265/XAB) Arizona's salt-gradient solar pond. Final report, May 1980-November 1984.** Hauskins, J.B.; Mancini, F.; Kolaja, R. (Arizona Transportation Research Center, Tempe (USA)). Oct 1987. 38p. NTIS, PC A03/MF A01.

The research project for designing and constructing a salt-gradient solar pond within the State of Arizona was requested by the Arizona Solar Energy Commission during a period when an oil embargo was still a possibility. The project was built at the Gray Mountain Maintenance Camp of the Arizona Department of Transportation, approximately 50 miles north of Flagstaff on Highway 89. The purpose of the study was to develop a reasonably low-cost method of generating useful thermal energy from a reusable resource. The solar pond has offered that potential. The salt-gradient solar pond is a body of water characterized by unique conditions which enable it to gather and store heat from the sun. The hot solar pond has been used for heating a maintenance building through a heat extraction process. The design of this facility was planned to provide a number of unique design and construction criteria described in the report. It is anticipated that the solar pond concept may become a viable alternative source of energy if the installation cost can be brought down to approximately $2.00 per square foot. The production of energy from such a facility is also dependent upon the quality of routine maintenance and other factors described in the report.

15 GEOTHERMAL ENERGY

1501 Resource Status And Assessment

28966 (DOE/SF/16385—T1) Hot dry rock venture risks investigation:. (Bechtel National, Inc., San Francisco, CA (USA)). Jan 1988. Contract AC03-86SF16385. 271p.

This study assesses a promising resource in central Utah as the potential site of a future commerical hot dry rock (HDR) facility for generating electricity. The results indicate that, if the HDR reservoir productivity equals expectations based on preliminary results from research projects to date, a 50 MWe HDR power facility at Roosevelt Hot Springs could generate power at cost competitive with coal-fired plants. However, it is imperative that the assumed productivity be demonstrated before funds are committed for a commercial facility. 72 refs., 39 figs., 38 tabs.

1502 Geology And Hydrology Of Geothermal Systems

28967 (LBL—24675) A summary of modeling studies of the Nesjavellir geothermal field, Iceland. Bodvarsson, G.S.;Bjornsson, S.;Gunnarsson, A.;Gunnlaugsson, E.;Sigurdsson,, O. Stefansson, V.;Steingrimsson, B. (Lawrence Berkeley Lab., CA (USA); Iceland Univ., Reykjavik; Reykjavik Municipal District Heating Service (Iceland); Icelandic National Energy Authority, Reykjavik; Braedraborgarstigur, Reykjavik (Iceland)). Jan 1988. Contract AC03-76SF00098. 11p. (CONF-880111—3). NTIS, PC A03. Order Number DE88006329/JAW.

From 13. workshop on geothermal reservoir engineering; Stanford, CA, USA (19 Jan 1988).

The Nesjavellir geothermal field in Iceland is being developed to provide the capital city of Reykjavik and surrounding areas with hot water for space heating. In the last few years, many wells have been drilled at the site and various geothermal studies have been conducted. The main upflow to the system is underneath the nearby Hengill volcano, and the natural recharge rate and enthalpy are estimated to be 65 kg/s and 1850 kJ/kg, respectively. An extensive vapor zone is believed to be present in the upflow region. Permeabilities and porosities of the system range between 1 and 50 md and 1 and 10 percent, respectively. In this paper, the characteristics of the Nesjavellir field are described and a three-dimensional numerical model of the resource in discussed. 15 refs., 11 figs., 1 tab.

28968 Molybdenum mineralization in an active geothermal system, Valles caldera, New Mexico. Hulen, J.B.; Nielson, D.L.; Goff, F.; Gardner, J.N.; Charles, R.W. (Univ. of Utah Research Institute, Salt Lake City (USA)). *Geology;* **15**: No. 8, 748-752(Aug 1987).

Shallow, sub-ore-grade molybdenite mineralization has been discovered in the active, high-temperature geothermal system penetrated by Continental Scientific Drilling Program corehole VC-2A at Sulfur Springs, in the western ring-fracture zone of the Valles caldera, New Mexico. This mineralization is hosted by fractured, quartz-sericitized, intracaldera ash-flow tuffs younger than 1.12 Ma. The molybdenite is an unusual, poorly crystalline variety that occurs in vuggy veinlets and breccia cements also containing quartz, sericite (illite), pyrite, and fluorite, as well as local sphalerite, rhodochrosite, and chalcopyrite. Fluid-inclusion data suggest that this assemblage was deposited from very dilute solutions at temperatures near 200°C. Geochemical modeling indicates that under restricted pH and fO_2 conditions at 200°C, the molybdenite and associated phases would be in equilibrium with hydrothermal fluids now circulating in the deep subsurface. The shallow molybdenite zone intersected in VC-2A may be the near-surface expression of deep, Climax-type stockwork molybdenum mineralization.

1503 Geothermal Exploration And Exploration Technology

28969 (DOE/ID/12549—T1) Geothermal investigations in Idaho: Geothermal resource analysis in Twin Falls County, Idaho:. Street, L.V.;DeTar, R.E. (Idaho Dept. of Water Resources, Twin Falls (USA); Bureau of Land Management, Boise, ID (USA)). Jul 1987. Contract FG07-84ID12549. 110p.

Increased utilization of the geothermal resource in the Twin Falls - Banbury area of southern Idaho has resulted in noticeable declines in the artesian head of the system. In order to determine the nature of the declines, a network of wells was identified for monitoring shut-in pressures and temperatures. In addition, a compilation of data and reconnaissance of the areal geology was undertaken in order to better understand the geologic framework and its relationship to the occurrence of the thermal waters in the system. The results of the monitoring indicate that while water temperatures have remained constant, the system shows a gradual overall decline in artesian pressure superimposed on fluctuations caused by seasonal use of the system. Well testing and the similarity of hydrographs resulting from well monitoring throughout the area suggest that there are no major hydrologic barriers to thermal water movement in the system and that wells are affected by increases and decreases in utilization of nearby wells. 46 refs., 13 figs., 1 tab.

1505 Economic And Financial Aspects

REFER ALSO TO CITATION(S) 28966

1508 Geothermal Power Plants

REFER ALSO TO CITATION(S) 28966

1509 Geothermal Engineering

28970 (BNL—40946) Elastomer liners for geothermal tubulars Y267 EPDM Liner Program:. Hirasuna, A.R.;Davis, D.L.;Flickinger, J.E.;Stephens, C.A. (L'Garde, Inc., Tustin, CA (USA)). Dec 1987. Contract AC02-76CH00016. 60p. (LTR—86-AH-127).

The elastomer, Y267 EPDM, has been identified as a hydrothermally stable material which can operate at temperatures in excess of 320°C. The goal of the Y267 Liner Program was to demonstrate the feasibility of using this material as a liner for mild steel tubulars to prevent or mitigate corrosion. If successful, the usage of EPDM lined pipe by the geothermal community may have a significant impact on operating costs and serve as a viable alternative to the use of alloyed tubulars. Tooling procedures were developed under this program to mold a 0.64 cm (0.25") thick Y267 EPDM liner into a tubular test section 61 cm (2') in length and 19.1 cm (7.5") in diameter (ID). A successful effort was made to identify a potential coupling agent to be used to bond the elastomer to the steel tubular wall. This agent was found to withstand the processing conditions associated with curing the elastomer at 288°C and to retain a significant level of adhesive strength following hydrothermal testing in a synthetic brine at 260°C for a period of 166 hours. Bonding tests were conducted on specimens of mild carbon steel

and several alloys including Hastelloy C-276. An objective of the program was to field test the lined section of pipe mentioned above at a geothermal facility in the Imperial Valley. Though a test was conducted, problems encountered during the lining operation precluded an encouraging outcome. The results of the field demonstration were inconclusive. 6 refs., 13 figs., 13 tabs.

28971 **(DOE/SF/16299—T4) Potential impacts of artificial intelligence expert systems on geothermal well drilling costs:.** Satrape, J.V. (Meridian Corp., Alexandria, VA (USA)). 1987. Contract AC03-86SF16299. 145p. (MCD—033-87-TA). NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88003239/JAW.

The Geothermal research Program of the US Department of Energy (DOE) has as one of its goals to reduce the cost of drilling geothermal wells by 25 percent. To attain this goal, DOE continuously evaluates new technologies to determine their potential in contributing to the Program. One such technology is artifical intelligence (AI), a branch of computer science that, in recent years, has begun to impact the marketplace in a number of fields. Expert systems techniques can (and in some cases, already have) been applied to develop computer-based "advisors" to assist drilling personnel in areas such as designing mud systems, casing plans, and cement programs, optimizing drill bit selection and bottom hole asssembly (BHA) design, and alleviating lost circulation, stuck pipe, fishing, and cement problems. Intelligent machines with sensor and/or robotic directly linked to AI systems, have potential applications in areas of bit control, rig hydraulics, pipe handling, and pipe inspection. Using a well costing spreadsheet, the potential savings that could be attributed to each of these systems was calculated for three base cases: a dry steam well at The Geysers, a medium-depth Imerial Valley well, and a deep Imperial Valley well. Based on the average potential savings to be realized, expert systems for handling lost circulations problems and for BHA design are the most likely to produce significant results. Automated bit control and rig hydraulics also exhibit high potential savings, but these savings are extremely sensitive to the assumptions of improved drilling efficiency and the cost of these sytems at the rig. 50 refs., 19 figs., 17 tabs.

28972 **(LA—11102-MS) Active cooling for downhole instrumentation: Preliminary analysis and system selection.** Bennett, G.A. (Los Alamos National Lab., NM (USA)). Mar 1988. Contract W-7405-ENG-36. 145p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88007080/JAW.

A feasibility study and a series of preliminary designs and analyses were done to identify candidate processes or cycles for use in active cooling systems for downhole electronic instruments. A matrix of energy types and their possible combinations was developed and the energy conversion process for each pari was identified. The feasibility study revealed conventional as well as unconventional processes and possible refrigerants and identified parameters needing further clarifications. A conceptual design or series od oesigns for each system was formulated and a preliminary analysis of each design was completed. The resulting coefficient of performance for each system was compared with the Carnot COP and all systems were ranked by decreasing COP. The system showing the best combination of COP, exchangeability to other operating conditions, failure mode, and system serviceability is chosen for use as a downhole refrigerator. 85 refs., 48 figs., 33 tabs.

1520 Geothermal Data And Theory

28973 **(LA—11160-HDR) Water geochemistry and hydrogeology of the shallow aquifer at Roosevelt Hot Springs, southern Utah: A hot dry rock prospect.** Vuataz, F.D.;Goff, F. (Los Alamos National Lab., NM (USA)). Dec 1987. Contract W-7405-ENG-36. 67p.

On the western edge of the geothermal field, three deep holes have been drilled that are very hot but mostly dry. Two of them (Phillips 9-1 and Acord 1-26 wells) have been studied by Los Alamos National Laboratory for the Hot Dry Rock (HDR) resources evaluation program. A review of data and recommendations have been formulated to evaluate the HDR geothermal potential at Roosevelt. The present report is directed toward the study of the shallow aquifer of the Milford Valley to determine if the local groundwater would be suitable for use as make-up water in an HDR system. This investigation is the result of a cooperative agreement between Los Alamos and Phillips Petroleum Co., formerly the main operator of the Roosevelt Hot Springs Unit. The presence of these hot dry wells and the similar setting of the Roosevelt area to the prototype HDR site at Fenton Hill, New Mexico, make Roosevelt a very good candidate site for creation of another HDR geothermal system. This investigation has two main objectives: to assess the water geochemistry of the valley aquifer, to determine possible problems in future make-up water use, such as scaling or corrosion in the wells and surface piping, and to assess the hydrogeology of the shallow groundwaters above the HDR zone, to characterize the physical properties of the aquifer. These two objectives are linked by the fact that the valley aquifer is naturally contaminated by geothermal fluids leaking out of the hydrothermal reservoir. In an arid region where good-quality fresh water is needed for public water supply and irrigation, nonpotable waters would be ideal for an industrial use such as injection into an HDR energy extraction system. 50 refs., 10 figs., 10 tabs.

28974 **(LBL—24774) Mathematical modeling of near-critical convection.** Cox, B.L.; Pruess, K.; McKibbin, R. (Lawrence Berkeley Lab., CA (USA)). Jan 1988. Contract AC03-76SF00098. 9p. (CONF-880111—4). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88007411/JAW.

From 13. workshop on geothermal reservoir engineering; Stanford, CA, USA (19 Jan 1988).

Fluid and heat flow ar temperatures approaching or exceeding that at the critical point (374{degree}C for pure water, higher for saline fluids) may be encountered in deep zones of geotehrmal systems and above cooling intrusives. Laboratory experiments have demonstrated strong enhancements in heat transfer at near-critial conditions. We have developed special numerical techniques for modeling porous flow at near-critical conditions, which can handle the extreme non-linearities in water properties near the critical point. Our numerical exeperiments show strong enhancements of coventive heat transfer at near-critical conditions;however, the heat transfer rates obtained in the numerical simulations are considerably smaller than those seen in the laboratory experiments by Dunn and Hardee. We discuss possible reasons for this discrepancy and develop suggestions for additional laboratory experiments. 11 refs., 7 figs., 2 tabs.

17 WIND ENERGY

1706 Wind Energy Engineering

28975 **Blade tip, finite aspect ratio, and dynamic stall effects on the Darrieus rotor.** Paraschivoiu, I.; Desy, P.; Masson, C. (Montreal Universite (Canada)). *Journal of Propulsion and Power;* **4**: 73-80(Feb 1988).

The objective of the work described in this paper was to apply the Boeing-Vertol dynamic stall model in an asymmetric manner to account for the asymmetry of the flow between the left and right sides of the rotor. This phenomenon has been observed by the flow visualization of a two-straight-bladed Darrieus rotor in the IMST water tunnel. Also introduced into the aerodynamic model are the effects of the blade tip and finite aspect ratio on the aerodynamic performance of the Darrieus wind turbine. These improvements are compatible with the double-multiple-streamtube model and have been included in the CARDAAV computer code for predicting the aerodynamic performance. Very good agreement has been observed between the test data (Sandia 17 m) and theoretical predictions; a significant improvement over the previous dynamic stall model was obtained for the rotor power at low tip speed ratios, while the inclusion of the finite aspect ratio effects enhances the prediction of the rotor power for high tip speed ratios. The tip losses and finite aspect ratio effects were also calculated for a small-scale vertical-axis wind turbine, with a two-straight-bladed (NACA 0015) rotor. 15 references.

20 ELECTRIC POWER ENGINEERING

2001 Power Plants And Power Generation

REFER ALSO TO CITATION(S) 28862, 28863, 28864, 28865, 28866, 28867, 28870, 28873, 28874, 28875

28976 **(EPRI-CS/EL—5593-Vol.1) Life assessment methodology for turbogenerator rotors: Volume 1, Improvements to the SAFER [Stress and Fracture Evaluation of Rotors] code rotor lifetime prediction software: Final report.** Wilson, G.H. (Jones (J.A.) Applied Research Co., Charlotte, NC (USA)). Mar 1988. 136p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920239/JAW.

The original SAFER (Stress and Fracture Evaluation of Rotors) code was developed by EPRI between 1976 and 1980 in response to concerns for turbo-generator rotor burst in the wake of the TVA Gallatin IP/LP rotor incident. The industry's response to the Gallatin burst was to inspect and retire any rotor which was suspected to have low creep ductility (especially Grade C 1CrMoV forgings) or a high ΔFATT (resulting from temper embrittlement during elevated temperature service) and, of course, which exhibited bore ultrasonic indications which by their density or distribution posed the threat of harboring or initiating cracks near the critical size. The conservatism inherent in these recommendations for retirement certainly removed many potentially dangerous rotors from service, but just as certainly led to the unnecessary retirement of many rotors which had not suffered any significant damage during their service history. The emphasis in the utility industry on extending the useful life of plant components, at the same time when fossil plants were being relegated to peaking duty and thus subjecting many turbines to much increased cyclic loading, resulted in critical examination of the economic basis of run/retire decisions and a need to understand the degree of risk involved in continued operation. This report discusses that examination and the improvements to the SAFER code as a result of that examination. 41 refs., 49 figs., 7 tabs.

28977 **(EPRI-CS/EL—5593-Vol.2) Life assessment methodology for turbogenerator rotors: Volume 2, SAFER [Stress and Fracture Evaluation of Rotors] Code Engineering Tutorial: Final report.** (Jones (J.A.) Applied Research Co., Charlotte, NC (USA)). Mar 1988. 95p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920240/JAW.

The Stress and Fracture Evaluation of Rotors (SAFER) computer code was developed by EPRI several years ago following the Gallatin rotor burst in 1974. SAFER combines the engineering disciplines of machine design, finite element stress analysis, heat transfer, non-destructive evaluation (NDE) techniques, mechanical metallurgy and fracture mechanics;this software tool provides the electric utility industry with a useful tool for an independent review and analysis of fully integral turbine-generator rotors with near bore flaws. The purpose of this SAFER Tutorial is to provide the utility engineer with an overview and understanding of the engineering disciplines used in the SAFER computer code and to provide several turbine-generator rotor example life assesment analyses with the appropriate input data to facilitate the technology transfer of the SAFER code to the electric utility industry. The intent of this Tutorial is not to train utility engineers to become turbine-generator rotor designers, but rather to provide them with enough information to make independent analyses to check and understand the OEM's recommendations and to schedule maintenance and inspection outages. This SAFER Tutorial is composed of two volumes. This report, Volume II, provides a brief description of the several engineering principels used in the SAFER Code. This Tutorial used in conjunction with the SAFER Computer Code User's Guide provides the necessary knowledge and methodology to conduct a turbine-generator rotor remaining life assessment. 85 refs., 33 figs., 1 tab.

28978 (EPRI-NP—5641-SR, pp 1.1.1-1.1.20) **Plant communications network system architecture.** Bayne, J.S. (Impell Pacific Corp., San Luis Obispo, CA (USA)). Feb 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920217/JAW. (CONF-8608110—).

From Seminar on integrated power plant computer communications; San Francisco, CA, USA (25 Aug 1986).

The design and development of a plant communications network (PCN) requires the integration of a number of philosophical and technical issues. This integration, once articulated can be referred to as the network architecture. In this paper the authors present a model architecture for a plant-wide industrial network, and discuss the major philosophical and technical issues. In general, PCNs interconnect management information systems, department level document processing and engineering systems, and shop floor manufacturing process control systems. PCNs are designed for campus-like settings that include several buildings geographically collocated on contiguous private property. The functions supported by the PCN fall into five main classes of services: data, telemetry, image, video, and voice. These are discussed before presentation of the 19-step implementation model.

28979 (EPRI-NP—5641-SR, pp 1.2.1-1.2.13) **Economic benefits of broadened local area networks for electric power plants.** Holmes, T. (Allen-Bradley Co., Ann Arbor, MI (USA)). Feb 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920217/JAW. (CONF-8608110—).

From Seminar on integrated power plant computer communications; San Francisco, CA, USA (25 Aug 1986).

The paper discusses economic benefits which influenced the choice of a broadband local area network for a power plant instead of an alternative multi-cable communication network. Broadband communication networks can offer significant economies over alternative technologies. One-time, cost avoidance savings and recurring annual savings are estimated to total $5.1 million in the first year. The cost/benefit analysis presented here can be used as a guide by other utilities to analyze communication networking alternatives. The paper also includes a discussion of local area network attributes relevant to the power plant installation.

28980 (EPRI-NP—5641-SR, pp 2.4.1-2.4.12) **Draft IEEE standard for interfacing power plant control and data networks.** Pillai, N. (Ontario Hydro, Toronto (Canada)). Feb 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920217/JAW. (CONF-8608110—).

From Seminar on integrated power plant computer communications; San Francisco, CA, USA (25 Aug 1986).

This standard defines the interface requirements to enable a user to interconnect main frame computers, control computers, programmable controllers, multiplexers, and other digital electronic or microprocessor based systems of various manufacturers used in power plants, for the purpose of exchanging control and/or data signals. Telecommunication and computer industry standards are used and referenced whenever appropriate. The ISO-OSI reference model is used as a guide; and application requirements specific to Power Plants are used. The multivendor trend in the supply of equipment is likely to continue for future plants. In addition, the use of personal computers is gradually expected to increase for control and non-control activities related to power production and administrative purposes. It is the intention of this standard to promote a multivendor network environment, where data can be exchanged between computing devices. This will enable the plant to integrate relative activities, automate power production and enhance the presentation of information.

28981 (EPRI-NP—5641-SR, pp 3.1.1-3.1.14) **Automation in the electric power industry - using MAP concepts.** Chupa, J. (Allen-Bradley Co., Inc., Ann Arbor, MI (USA)). Feb 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920217/JAW. (CONF-8608110—).

From Seminar on integrated power plant computer communications; San Francisco, CA, USA (25 Aug 1986).

The paper begins with a general MAP (Manufacturing Automation Protocol) overview. Included in this overview is a specific discussion of the application entities contained in MAP. The second part of the paper deals with specific electrical power company applications relative to the MAP specification. Some of these applications are process control, SCADA, coal handling systems, energy management, plant security systems and substation applications.

28982 (EPRI-NP—5641-SR, pp 5.8.1-5.8.7) Evolution of an approach to configuration management. Bowes, E.V. (Virginia Power Co., Richmond (USA)). Feb 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920217/JAW. (CONF-8608110—).

From Seminar on integrated power plant computer communications; San Francisco, CA, USA (25 Aug 1986).

Virginia Power is currently in the process of developing and implementing an automated Equipment Data System/Bill of Materials (EDS/BOM) which will support many aspects of maintenance management, including planning, component tracking, materials management and historical reporting. The EDS/BOM system is being developed as an application of a comprehensive automated Work Planning and Tracking System (WPTS) which has become the main system for use in station maintenance management. In addition to these programs, the Company has also developed a Cost Planning and Tracking System (CPTS) and has invested over $20 million in an equipment mark numbering and drawing update program. As these programs have matured, the need has been recognized for a structured configuration management program to protect the multi-million dollar investment in documents and data, and to assure the existence of reliable information as a foundation for improved efficiency in maintenance management and engineering.

2002 Environmental Control Technology

REFER ALSO TO CITATION(S) 28871, 29446

28983 (PB—88-157466/XAB) Power plant cumulative environmental impact report for Maryland, March 1986. Biannual report No. 5. Miller, P.E. (Maryland Dept. of Natural Resources, Annapolis (USA). Power Plant Siting Program). Mar 1986. 337p. (PPSP-CEIR—5). NTIS, PC A15/MF A01.

See also PB—82-219437.

The Cumulative Environmental Impact Report (CEIR) is a compilation of all studies relating to the impact of power plants in Maryland and adjacent states upon Maryland's environment. The CEIR is published biannually. The present report is an assessment of impacts using results of studies performed in 1983 and 1984. Topics discussed in detail in the edition are: (1) The Electric Utility Industry in Maryland; (2) Need for Power; (3) Air Impact; (4) Aquatic Impact; (5) Radiological Impacts; (6) Groundwater Impact; (7) Acid Deposition; and (8) Alternative Power Supply Technologies.

2003 Power Transmission And Distribution

REFER ALSO TO CITATION(S) 29446

28984 (AD-A—187929/5/XAB) Quality of electrical power and high-technology equipment. Master's thesis. Decker, J.R. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Systems and Logistics). Sep 1987. 87p. (AFIT/GEM/LSR—87S-4). NTIS, PC A05/MF A01.

The purpose of this research was to determine if Air Force Bases in the Continental United States were receiving quality electrical power in accordance with ANSI C84.1. An investigation into factors influencing quality electrical power and Power Conditioning and Continuation Interface Equipment was also conducted. There were four research objectives in this effort: (1) Determine if Air Force Bases in the Continental United States are receiving quality electrical power in accordance with ANSI C84.1. (2) Determine how grounding impacts the operation of high-technology equipment. (3) Determine how power disturbances on the distribution grid affect the operation of high-technology equipment. (4) Identify the different types of Power Conditioning and Continuation Interface Equipment (PCCIE) and determine how they help and when they are applicable. Over 60% of the individuals in the sample did not know if the electrical power they received met ANSI C84.1. The most serious ground problem the Civil Engineer faces is the isolated grounding scheme. This is due to safety and operational factors. It appears that electrical power disturbances cause less operational problems with high technology equipment that has traditionally been believed. Operational problems due to electrical power represent at most 10% of the total operational problems experienced by high technology equipment. Several types of Power Conditioning and Continuation Interface Equipment were identified and concept of operations explained.

28985 (CONF-880433—4) 138 kV 12-phase as an alternative to 345 kV 3-phase. Stewart, J.R.;Hudson, T.L. (Power Technologies, Inc., Schenectady, NY (USA); Oak Ridge National Lab., TN (USA)). Apr 1988. Contract AC05-84OR21400. 7p.

From Southeastcon '88 conference and exhibit; Knoxville, TN, USA (11 Apr 1988).

Recent high phase order reserch has resulted in a 138 kV (phase-to-ground) 12-phase line design which is a realistic alternatice to 345 kV 3-phase transmission. This paper presnts the results of an experimental and analytical program which included construction of a 12-phase steel lattice portal tower special insulators, consttruction of a 12-phase substation, and subsequent energization of the world's first 12-phase power transmission line. Impedences, electrical environmental effects (radio noise, audible noise, and electric fields) are among the parameters measured and evaluated. This 12-phase design is compared with sevral existing 345 kV 3-phase lines for thermal and surge impedance loading, electrical environmental effects and physical size requirements. The 12-phase design offers comparable loading in less space with reduced electrical environmental impact. This is illustrative of the possibilities of high phase order as a replacement for 3-phase at other voltage levels. 9 refs., 13 figs., 2 tabs.

28986 (EPRI-EL—5667) Lightning flash characteristics: 1986, Interim report. Orville, R.E.; Henderson, R.W.; Pyle, R.B. (State Univ. of New York, Albany (USA). Dept. of Atmospheric Science). Feb 1988. 38p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920220/JAW.

A magnetic direction finding network for the detection of lightning cloud-to-cloud strikes is operating in the eastern United States. The area covered extends from Maine to Florida and slightly to the west of the Mississippi River in the south. Time, location, flash polarity, multiplicity (stroke count), and magnetic field initial peak amplitude are recorded in real time. Flash locations, time, polarity, peak current, and multiplicity are displayed routinely for research and operational purposes. The information is available to utilities through a satellite communications link for real time access or by phone lines for access to historical data. The flash information is being compiled into a data base to provide statistical information necessary for the prediction of the surge performance of electric power lines and the improvement of surge protection practices. Results for the year 1986 are presented in this report. 3 refs., 21 figs.

21 NUCLEAR POWER PLANTS

REFER ALSO TO CITATION(S) 29825

28987 (INIS-mf—11663) Operational management in nuclear power plants - a model derived from an analysis of malfunctions and spurious activations due to operator errors. Hoffmann, E. (Bochum Univ. (Germany, F.R.). Fakultaet fuer Maschinenbau). 18 Jul 1986. 173p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88753299/JAW.

Requirements to be made on operational management should consider deficiencies in the working system, personal disposition to errors, and the psychological structure of process control. This results in a model for NPP operation comprising the following prop-

erties: hierarchical structure, graduation according to importance, modularity, standardized mandatory behaviour patterns, choice of individual depth of information, underlining and weighting of alarms and, as new principles of incident handling, the objective of trainable action modules for incident control, the application of operating modes orientated to symptoms, conditions or protection objectives, the reduction of the amount of information offered, and the consultation of advisory groups.

2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

REFER ALSO TO CITATION(S) 29072, 29082, 29086, 29091, 29093, 29095, 29096, 29097, 29107, 29110, 29113, 29119, 29120, 29121, 29122, 29123, 29124, 29125, 29186, 29192, 29194, 29200, 29214, 29444

28988 (EGG-M—36287) Effectiveness and safety aspects of selected decontamination methods for LWRs [light-water reactors]: "The Recontamination Experience". Duce, S.W. (EG and G Idaho, Inc., Idaho Falls (USA)). 1987. Contract AC07-76ID01570. 26p. (CONF-8710111—41). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006712/JAW.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

During the years 1983 to 1986 chemical decontaminations of primary recirculation system piping was performed at many boiling water reactors in the United States. At most facilities the recirculation piping was replaced following the chemical decontamination. At a few facilities the piping was inspected for cracks and weld overlays were applied to any identified cracks. This paper presents information on the recontamination of these recirculation systems following one to two fuel cycles.

28989 (NUREG/CP—0091-Vol.1, pp 309-316) **Future directions in boiling water reactor design.** Wolfe, B.; Wilkins, D.R. (GE Nuclear Energy, San Jose, CA (USA)). Feb 1988. NTIS, PC A20/MF A01 - GPO. Order Number TI88006850/JAW. (CONF-8710111—Vol.1).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

The Advanced Boiling Water Reactor (ABWR) is being developed by an international team of BWR manufacturers to respond to worldwide utility needs in the 1990's. The ABWR incorporates the best proven features from BWR designs in Europe, Japan and the US and application of leading-edge technology. Key features of the ABWR are internal recirculation pumps; fine-motion, electro-hydraulic control rod drives; digital control and instrumentation; multiplexed, fiber optic cabling network; pressure suppression containment with horizontal vents; cylindrical reinforced concrete containment; structural integration of the containment and reactor building; severe accident capability; state-of-the-art fuel; advanced turbine/generator with 52" last-stage buckets; and advanced radwaste technology. The Tokyo Electric Power Company, Inc. recently announced the selection of GE Nuclear Energy, Hitachi Ltd. and Toshiba Corporation to design and construct two lead Advanced Boiling Water Reactors as Units 6 and 7 at the Kashiwazaki-Kariwa Nuclear Power Station. The three companies will form an international joint venture to design the plant and supply the equipment. International cooperative efforts are also under way aimed at development of a simplified BWR employing natural circulation and passive safety systems. This BWR concept, while only in the conceptual design stage, shows significant technical and economic promise.

28990 (OEFZS—4431) Calculations with THYDE-B1 for the test PO-SB-7 in PIPER-1, Pisa, Italy. Sonneck, G.; Pfau, H. (Oesterreichisches Forschungszentrum Seibersdorf Ges.m.b.H., Institut fuer Energie- und Anlagentechnik). (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H.). Jan 1988. 26p. (In German). (EA—309/88). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702617/JAW.

The test PO-SB-7 from the BWR test facility PIPER-1 in Pisa, Italy, was chosen as the International Standart Problem (ISP) 21 by CSNI, OECD. The Department for Energy and Engineering is participating in this exercise. This report describes the input and the calculations using the Japanese code THYDE-B1. As the experiment has not yet been run the results can only be compared to counterpart test in USA and Japan. They seem to be reasonable. Additionally THYDE-B1 proves to have advantages over similar codes. 10 refs., 8 figs., 4 tabs.

2102 Power Reactors, Non-breeding, Light-water Moderated, Non-boiling Water Cooled

REFER ALSO TO CITATION(S) 29079, 29080, 29082, 29083, 29086, 29087, 29088, 29089, 29092, 29093, 29094, 29095, 29097, 29098, 29108, 29110, 29119, 29121, 29122, 29123, 29124, 29125, 29127, 29132, 29133, 29136, 29186, 29192, 29194, 29200, 29214, 29365

28991 (EGG-M—39286) Single and two-phase natural circulation in Westinghouse pressurized water reactor simulators: Phenomena, analysis and scaling. Schultz, R.R.; Chapman, J.C.; Kukita, Y.; Motley, F.E.; Stumpf, H.; Chen, Y.S.; Tasaka, K. (EG and G Idaho, Inc., Idaho Falls (USA); Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment; Los Alamos National Lab., NM (USA); Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research). 1987. Contract AC07-76ID01570. 12p. (CONF-871275—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006713/JAW.

From ASME international symposium on natural circulation; Boston, MA, USA (17 Dec 1987).

Natural circulation data obtained in the 1/48 scale W four loop PWR simulator - the Large Scale Test Facility (LSTF) are discussed and summarized. Core cooling modes, the primary fluid state, the primary loop mass flow and localized natural circulation phenomena occurring in the steam generator are presented. TRAC-PF1 LSTF model (using both a 1 U-tube and a 3 U-tube steam generator model) analyses of the LSTF natural circulation data including the SG recirculation patterns are presented and compared to the data. The LSTF data are then compared to similar natural circulation data obtained in the Primarkreislaufe (PKL) and the Semiscale facilities. Based on the 1/48 to 1/1705 scaling range which exists between the facilities, the implications of these data towrard natural circulation behavior in commercial plants are briefly discussed.

28992 (IEN-DINEU—13/84) Re-evaluation of thermohydraulic parameters of the 10MW TRIGA reactor. Apaico, M.J. (Instituto de Engenharia Nuclear, Rio de Janeiro (Brazil)). Dec 1984. 15p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702559/JAW.

The reproduction of thermohydraulic parameters of the 10MW TRIGA reactor, determined by General Atomic Company (G.A.C.), as reference for thermohydraulic calculations of the (Radioisotope Production Reactor) R.P.R. project, is presented. (M.C.K.).

28993 (INIS-BR—997) Safety of nuclear installations. Esteves, R.G. (NUCLEBRAS, Rio de Janeiro (Brazil)). 1987. 21p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702581/JAW.

The safety philosophy of a PWR type reactor distinguishing three levels of safety, is presented. At the first level, the concept of reactivity defining coefficients which measure the reactivity variation is introduced. At the second level, the reactor protection system establishing the design criteria to assure the high reliability, is defined. At the third level, the protection barriers to contain the consequences of accident evolution, are defined. (M.C.K.).

28994 (INIS-BR—1000) Operation of nuclear power plants. Francisco, J.M.D. (FURNAS, Rio de Janeiro (Brazil)). 1987. 13p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702584/JAW.

The main characteristics of the design, operation, organization and operation team formation of the Almirante Alvaro Alberto Nuclear Power Plant-Angra-1, are presented. (M.C.K.).

28995 **(INIS-BR—1014) Problem of licensing and safety of nuclear power plants.** Silva, R.A. da. (FURNAS, Rio de Janeiro (Brazil)). 1987. 8p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702598/JAW.

The historical evolution of licensing process of nuclear power plants is presented. The designs carried out by FURNAS for constructing Angra-1 reactor and its contribution to the Brazilian CNEN in de licensing process, are evaluated. The aims of FURNAS Research Programs are determined and the safety goals are established. (M.C.K.).

2103 Power Reactors, Non-breeding, Graphite Moderated

REFER ALSO TO CITATION(S) 29115, 29116, 29128, 29129

2104 Power Reactors, Non-breeding, Otherwise Moderated Or Unmoderated

REFER ALSO TO CITATION(S) 29131

28996 **(NUCLEBRAS-CDTN—520) Determination of heterogeneous medium parameters by single fuel element method.** Veloso, M.A.F. (Centro de Desenvolvimento da Tecnologia Nuclear, Belo Horizonte (Brazil)). 1985. 118p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88702612/JAW.

The neutron pulse propagation technique was employed to study an heterogeneous system consisting of a single fuel element placed at the symmetry axis of a large cylindrical D_2O tank. The response of system for the pulse propagation technique is related to the inverse complex relaxation length of the neutron waves also known as the system dispersion law rho (ω). Experimental values of rho (ω) were compared with the ones derived from Fermi age - Diffusion theory. The main purpose of the experiment was to obtain the Feinberg-Galanin thermal constant (γ), which is the logaritmic derivative of the neutron flux at the fuel-moderator interface and a such a main input data for heterogeneous reactor theory calculations. The γ thermal constant was determined as the number giving the best agreement between the theoretical and experimental values of rho (ω). The simultaneous determination of two among four parameters eta,rho,tau and L/sub s/ is possible through the intersection of dispersion laws of the pure moderator system and the fuel moderator system. The parameters tau and eta were termined by this method. It was shown that the thermal constant γ and the product eta rho can be computed from the real and imaginary parts of the fuel-moderator dispersion law. The results for this evaluation scheme showns a not stable behavior of γ as a function of frequency, a result not foreseen by the theoretical model.

2105 Power Reactors, Breeding

REFER ALSO TO CITATION(S) 29116, 29117, 29118, 29135

28997 **Seismic analysis of LMR reactor tanks.** Chang, Y.W.; Ma, D.C.; Gvildys, J.; Liu, W.K. (Argonne National Lab., IL (USA); Northwestern Univ., Evanston, IL (USA)). *Nuclear Engineering and Design;* **106**: No. 1, 19-33(Feb 1988).

This paper deals with the methods of seismic analysis of LMR reactor tanks. Mathematical models of a reactor tank and LMR plant are given. Various methods of seismic analysis suitable for the analysis of fluid-structure interaction of LMR plants and their advantages and drawbacks are described. Emphasis is placed on efficiency of the numerical algorithm. The computer code FLUSTR-ANL, developed for seismic analysis of LMR components, is also described.

2106 Power Reactors, Auxiliary, Mobile, Package, And Transportable

REFER ALSO TO CITATION(S) 29116, 29117, 29118, 29151

2107 Regulation And Licensing

REFER ALSO TO CITATION(S) 29078, 29090, 29099

28998 **(EPRI-NP—5640-Vol.1) Nuclear plant modification and design control: Guidelines for generic problem prevention (NCIG-06): Volume 1, Summary of results: Final report.** Moran, J.V.; Shulman, M.N. (Cygna Energy Services, Walnut Creek, CA (USA)). Mar 1988. 40p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920229/JAW.

The Nuclear Construction Issues Group (NCIG) initiated a task in response to the increasing emphasis being placed on the modification and design control (MDC) process at nuclear power plants. The purpose of this NCIG task was to identify generic problems relating to modification activities, to determine where those problems occur in the MDC process, to identify causes of the problems and to provide guidelines to eliminate such problems in the future. This report, volume 1, is a summary document which briefly describes each element of the MDC process, the generic problems, root causes, and guidelines.

28999 **(EPRI-NP—5640-Vol.2) Nuclear plant modification and design control: Guidelines for generic problem prevention (NCIG-06): Volume 2, Task report: Final report.** Moran, J.V.; Shulman, M.N. (Cygna Energy Services, Walnut Creek, CA (USA)). Mar 1988. 172p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920230/JAW.

The Nuclear Construction Issues Group (NCIG) initiated a task in response to the increasing emphasis being placed on the modification and design control (MDC) process at nuclear power plants. The purpose of this NGIC task was to identify genertic problems relating to modification activities to determine where those problems occur in the MDC process, to identify causes of the problems and to provide guidelines to eliminate such problems in the future. This report, volume 2, is a thorough document providing detailed results of all task activities including: a review of the task methodology;a description of each MDC element;generic problems;generic problems;examples;root causes;guidelines;and supporting information.

2108 Economics

REFER ALSO TO CITATION(S) 29134

29000 (DOE/ER/75172—5, pp 60-62) **Development and use of CASLE code.** Hymas, M.L. (Idaho State Univ., Pocatello (USA)). 1987. NTIS, PC A06/MF A01. Order Number DE88005041/JAW. (CONF-8703231—Summs.).

From Western region American Nuclear Society student conference: nuclear technology for the year 2000; Albuquerque, NM, USA (19 Mar 1987).

CASLE is a user friendly, power cycle analysis code originated by Warren Madsen of EG & G Idaho, Inc. The code was completed at Idaho State University in conjunction with EG & G. Included in the code is an economic analysis section which will evaluate a power system and its individual components. CASLE is used by industrial and educations institutions. The thermodynamic approach of CASLE, which is based on first and second law analysis, is examined. Economic cost analysis of system improvements is discussed. Examples of various power cycles are compared.

29001 **(INIS-BR—999) Industrial development - consequences about the implantation of Brazilian Nuclear Program.** Syllus, C. (NUCLEBRAS, Rio de Janeiro (Brazil)). Jul 1987. 59p. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88702583/JAW.

The strategy to promote the growing industry participation in the Brazilian Nuclear Program, the difficulties, the measurements adopted for overcoming and the results obtained in terms of industrial development, are presented. (M.C.K.).

29002 **Computerized approach for developing a postmaintenance testing program.** Read, J.W. (Pickard, Lowe & Garrick, Newport Beach, VA (USA)). *Transactions of the American Nuclear Society;* **54**: 188-191(1987). (CONF-870837—).

From 13. American Nuclear Society international meeting on nuclear power plant operation; Chicago, IL, USA (30 Aug 1987).

Equipment taken out of service for repair by the plant maintenance organization is normally subjected to testing following the repair to assure the equipment can be returned to service. The types of testing required depend on the extent and type of the maintenance activity performed on the equipment. The testing itself is performed by the maintenance organization or in combination with the operations organization, depending on the requirements of the tests. These tests are normally defined in the maintenance work order by the maintenance work planner. Because the identification and specification of the testing required has been based on the planner's experience, and because it is time-consuming to prepare work orders, and because identifying the required postmaintenance tests is sometimes inconsistent or incorrect, Pickard, Lowe and Garrick, Inc. (PLG), has developed a computerized approach to identify the postmaintenance testing requirements. The PLG program contains computerized test guidelines for 71 generic plant components. This computer program (PMT) provides a simple, yet effective, tool for the maintenance planner and job supervisor to use in identifying component level postmaintenance testing requirements.

22 NUCLEAR REACTOR TECHNOLOGY

2202 Components And Accessories

REFER ALSO TO CITATION(S) 29081, 29084, 29126, 29185, 29187, 29188, 29189, 29190, 29191, 29193, 29195, 29197, 29198

29003 **(NUREG/CR—4785) Review and evaluation of design analysis methods for calculating flexibility of nozzles and branch connections.** Moore, S.E.; Rodabaugh, E.C.; Mokhtarian, K.; Gwaltney, R.C. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 106p. (ORNL—6339). NTIS, PC A06/MF A01 - GPO. Order Number TI88002772/JAW.

Modern piping system design generally includes an analytical determination of displacements, rotations, moments, and reaction forces at various postions along the piping system by means of a flexibility analysis. The analytical model is normally based on a strength-of-materials description of the piping system as an interconnected set of straight and curved beams, along with "flexibility factors" that are used to compensate for inaccuracies in the model behavior. This report gives an in-depth evaluation of the various analytical descriptions of the flexibility factors associated with piping system branch connection and nozzles. Recommendations are given for developing needed improvements. 59 refs., 29 figs., 26 tabs.

2203 Fuel Elements

29004 **(CONF-8709189—7) Prospects of stable high-density dispersion fuels.** Hofman, G.L.; Neimark, L.A. (Argonne National Lab., IL (USA)). Oct 1987. Contract W-31109-ENG-38. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005914/JAW.

From International meeting on Reduced Enrichment for Research and Test Reactors (RERTR); Buenos Aires, Argentina (28 Sep 1987).

The majority of research and test reactors around the world employ aluminum fuel element designs that contain dispersed powders of uranium compounds as fuel. Specifically, two compounds are used: (1) uranium oxide (U_3O_8) and (2) an uranium aluminide mixed phase composed of the intermetallic compounds UAl_2, UAl_3, and UAl_4, all made with highly enriched uranium (HEU), i.e., 93% ^{235}U. The reduction of ^{235}U enrichment to below 20%, to so-called low enriched uranium (LEU), requires the use of higher density fuels for those applications where increased fuel loading is not feasible. Fuel dispersant loading is, in practice, limited to approximately 45 vol %. Fuel development in the Reduced Envichment Research and Test Reactors (RERTR) program has focused on uranium silicides (U_3Si and U_3Si_2) as the most promising high-density fuels. The compounds of U_6Fe and U_6Mn as well as U_3Si containing Cu were tested as part of the search for stable very-high-density fuels. The problem of breakaway swelling in high-density fuel compounds is attributed to radiation-induced amorphization of these compounds. Alloy additions are a possible means by which the crystal structure of very-high-density compounds can be strengthened and preserved to high irradiation doses. Tailoring metallurgical treatment during fabrication, to avoid thermodynamically weak compounds, appears promising for certain compound combinations. 5 refs., 2 figs.

29005 **Irradiation behavior of low-enriched U_6Fe-Al dispersion fuel elements.** Hofman, G.L.; Domagala, R.F.; Copeland, G.L. (Argonne National Lab., IL (USA);Oak Ridge National Lab., TN (USA)). *Journal of Nuclear Materials;* **150**: No. 2, 238-243(Oct 1987). Contract W-31-109-ENG-38.

Letter-to-the-editor.

An irradiation test of miniature fuel plates containing low-enriched (20% ^{235}U)U_6Fe dispersed and clad in Al was performed. The postirradiation examination shows U_6Fe to form extensive fission gas bubbles at burnups of only ≃ 20% of the original 20% fuel enrichment. Plate failure by fission gas-driven pillowing occurred at ≃ 40% burnup. This places U_6FE at the lowest burnup capability among low enriched dispersion fuels that have been tested for use in research and test reactors.

2204 Control Systems

REFER ALSO TO CITATION(S) 28978, 28979, 28982

29006 **(EPRI-NP—5641-SR, pp 3.2.1-3.2.17) PG and E Diablo canyon nuclear power plant, plant information management system, integrated communications system.** Burnette, L.; Black, T.; Bayne, J. (Impell Pacific Corp., San Luis Obispo, CA (USA)). Feb 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920217/JAW. (CONF-8608110—).

From Seminar on integrated power plant computer communications; San Francisco, CA, USA (25 Aug 1986).

This paper presents the architecture, design and implementation of a plant-wide industrial network for Pacific Gas and Electric Company's (PG & E) Diablo Canyon Nuclear Power Plant (DCPP). The network is referred to as the Integrated Communications System (ICS) and provides a broadband backbone cable plant and communications infrastructure that are capable of reliably carrying data, video, telemetry, image and voice information throughout the plant site. It is used to interconnect 400-800 IBM 3270 PC workstations to the site's numerous computer systems, as well as providing workstation users with several value-added applications.

29007 **(EPRI-NP—5641-SR, pp 3.3.1-3.3.24) Overview of the Nuclear Information Services function.** Van Beeck, J.J.; Groves, J.E. (South California Edison Co., San Clemente (USA)). Feb 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920217/JAW. (CONF-8608110—).

From Seminar on integrated power plant computer communications; San Francisco, CA, USA (25 Aug 1986).

The authors have directed this paper to senior officers and managers of Nuclear generation facilities. It is encouraged that the concept of using the Nuclear Information Services function as an additional tool of management be reviewed in more depth by these leaders of their industry to determine the appropriateness of such an approach within their organizations. The results achieved at the Southern California Edison Company San Onofre Nuclear Generation Station have been highly beneficial in terms of productivity and increased assurances of compliance. In addition, there has been

a positive contribution to the quality of work life of the professional nuclear power plant employee. The Nuclear Information Services function was implemented over a relatively short period of time. This included the successful implementation of a number of large host based Nuclear Information Systems. Several guidelines for the development and management of this function are suggested.

29008 (EPRI-NP—5641-SR, pp 3.6.1-3.6.15) **Large-scale implementation of computerized plant control and monitoring in CANDU power plants.** Chan, D.; Pauksens, J.; Popovic, J.R. (Atomic Energy of Canada Ltd., Mississauga, Ontario). Feb 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920217/JAW. (CONF-8608110—).

From Seminar on integrated power plant computer communications; San Francisco, CA, USA (25 Aug 1986).

The use of computers in CANDU has evolved over several generations of reactors. Current CANDU power reactors incorporate a very high degree of computerization in automatic reactor and plant control and monitoring functions. Power plant computerization gives rise to special considerations which must be addressed in the design process. In particular: the need to process large volumes of plant data, impacting on both the design process and the system architecture, the need to assure uniformity of approach in handling the various plant systems, the need for appropriate interaction between plant system designers, computer system designers, and plant operators, the need for a high degree of system reliability. In this paper the authors describe how these considerations were addressed in current CANDU power plants. The systems described provide proven answers to the questions involved in designing a large, modern, integrated power plant monitoring and control system. Also they provide the foundation for the new distributed multiplexing and control system which will be used in the next generation of CANDU power plants.

29009 (EPRI-NP—5641-SR, pp 3.7.1-3.7.12) **Data exchange: application for integrated power plant database systems.** Cimento, A.; Stuart, R.; Reiter, A. (Computer Integrated Management Inc., San Francisco, CA (USA)). Feb 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920217/JAW. (CONF-8608110—).

From Seminar on integrated power plant computer communications; San Francisco, CA, USA (25 Aug 1986).

A new technology, developed under a Research and Development program, is available to tie together existing, incompatible computer systems and provide a cost-effective way to implement an integrated power plant database. The Data Exchange is a system which integrates data stored on different computers and file systems. Data translation and communications functions are provided with the system, allowing existing application programs to have access to integrated data without modifying the existing physical files. The Data Exchange can work with any integrated data model and can be easily expanded or modified as computer systems are added or as data requirements change. This paper provides an overview of the Data Exchange system and its operation. The use of the Data Exchange system in implementing an integrated power plant database is described. The benefits of such an approach are presented and illustrated through an electric utility example.

29010 (EPRI-NP—5641-SR, pp 3.8.1-3.8.14) **VAX 8200 cluster with MicroVAX II/GPX workstations.** Vorce, R.G. (Fairchild Weston Systems Inc., Sarasota, FL (USA)). Feb 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920217/JAW. (CONF-8608110—).

From Seminar on integrated power plant computer communications; San Francisco, CA, USA (25 Aug 1986).

The purpose of the paper is to discuss a system configuration designed to simultaneously support both the NRC mandated Safety Parameter Display System and the Plant Process Computer Replacement System requirements. The computer system uses a pair of redundant VAX 8200 processors connected in a cluster configuration with shared disk and tape resources. The pair of computers provide each other with automatic failover capability in case of a unit malfunction. The clustered computers communicate with each other over the dual-path, high-bandwidth Computer Interconnect bus and with the MicroVAX II/GPX and VAXstar workstations over an Ethernet Local Area Network link. The VAX 8200 computers and the MicroVAX II workstations all use DEC's VAX/VMS software operating system. Workstations are placed in the Control Room, Computer Room, Technical Support Center, Emergency Offsite Facility and Engineering Support Center. These MicroVAX II/GPX and VAXstar workstations have access to all the data that is being acquired by the host computers and in addition they provide both independent compute power and in the case of the MicroVAX II/GPX offer software development capability at each of their locations. Common processing and display software is shared. Special purpose processing and display routines can be generated for each workstation to optimize its usefulness without affecting the performance of the host computer or any of the other independent workstations. A high system availability factor is assured by maintaining one of the computers in a hot standby mode of operation. The availability factor is further improved by including redundant Multiplex Preprocessors between the data acquisition subsystem and the computer subsystem.

29011 (EPRI-NP—5641-SR, pp 4.1.1-4.1.10) **Networking at Millstone III - Northeast Utilities' solution to distributed systems and network implementation.** Boyd, J.W. Jr. (Northeast Utilities Service Co., Hartford, CT (USA)). Feb 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920217/JAW. (CONF-8608110—).

From Seminar on integrated power plant computer communications; San Francisco, CA, USA (25 Aug 1986).

To reduce regulatory risk, Northeast Utilities (NU) began to attack the post Three Mile Island regulatory environment with distributed computer systems. NU selected several vendors to supply key functions to meet Millstone III's aggressive construction schedule. But by distributing the risk, NU also distributed vital information and design control. Paramount to creating an unabridged plant computer information system was cohesively tying these distributed systems into one network. The issues of schedule, failover, fault isolation, cabling and technology are discussed. The underlying importance of simplicity is stressed as a key element to success.

29012 (EPRI-NP—5641-SR, pp 4.2.1-4.2.12) **Nine Mile Point's data communication network.** Slater, J.C. (Niagara Mohawk Power Corp., Lycoming, NY (USA)). Feb 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920217/JAW. (CONF-8608110—).

From Seminar on integrated power plant computer communications; San Francisco, CA, USA (25 Aug 1986).

This report presents Niagara Mohawk's past and current use of data communication network technologies as well as a predictive look at what requirements may be needed in the future. Prior to the Three-Mile-Island accident, point-to-point leased lines were adequate for off-site data communications, while point-to-point dedicated lines handled on-site communications. Following Three-Mile-Island, the Nuclear Regulatory Commission (NRC) and a general acceptance of computers caused a drastic increase in data communications both on and off-site. Niagara Mohawk designed and implemented a distributed packet-switching network to meet this challenge. This network serves a variety of computers and terminals at both nuclear plants as well as their supporting facilities. Future requirements will include a need to support video, file transfers, and real-time data from process monitoring instrumentation. Also, as process control becomes more established, a protocol such as MAP may be needed (not necessarily MAP).

29013 (EPRI-NP—5641-SR, pp 4.3.1-4.3.19) **Automated technical specification information system (ATSIS).** Groves, J.E.; Mills, R.H.; Van Beeck, J.J.; Glazer, K.A. (Southern California Edison Co., San Clemente (USA)). Feb 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920217/JAW. (CONF-8608110—).

From Seminar on integrated power plant computer communications; San Francisco, CA, USA (25 Aug 1986).

The Automated Technical Specification Information System (ATSIS) is a significant step for the electricity generating industry in that it represents another tool to support the movement into more complex and highly regulated atmosphere into which the in-

dustry has been forced. The pre-event analysis and approved response determination which is readily retrievable at the event is a task for which the computer is an ideal medium. ATSIS is a computerized system which can factor new inoperability and out-of-limit event(s) and into the current status of the nuclear electric generating station. It provides the currently applicable Operating License Technical Specification Limiting Conditions For Operation Action Requirements with time limits calculated. Changes in the reactor mode and/or coincident conditions corresponding to Technical Specification applicability conditions can also be evaluated for impact determination. It provides the trail from the new event to the Action Requirements even with the policy of cascading impacts. The communication of this and similar operating status data via a network of computer terminals is powerful operating tool.

29014 (EPRI-NP—5641-SR, pp 4.4.1-4.4.11) **Front end data link processor.** Wallace, J.J. (Wisconsin Public Service Corp., Green Bay (USA)). Feb 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920217/JAW. (CONF-8608110—).

From Seminar on integrated power plant computer communications; San Francisco, CA, USA (25 Aug 1986).

It is possible to expand the data acquisition capabilities of an existing process computer to include other dedicated computer based systems, provided each system has at least minimal data link capabilities. The following paper discusses the addition of three computer based acquisition systems to a Honeywell 4500C (also designated the 45000) running the SEER system. Only one data link port was required to support the link. Each of the three specialized systems implemented data link protocols used by their suppliers in previous projects: none of the three were compatible with Honeywell's protocol. Part one of the following provides a generic overview of the project and would be relevent to the operator of any process system interested in expansion. Part two provides specific details of this project and may serve to provide performance benchmarks to those who wish to consider a similar project.

29015 (EPRI-NP—5641-SR, pp 4.5.1-4.5.15) **Designing a distributed multiplexing and control system.** Whittall, W.R. (Atomic Energy of Canada Ltd., Mississauga, Ontario). Feb 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920217/JAW. (CONF-8608110—).

From Seminar on integrated power plant computer communications; San Francisco, CA, USA (25 Aug 1986).

AECL is developing a new Distributed Multiplexing and Control System as an improvement for the existing CANDU 600 design and for use in the new CANDU 300 design. The system provides major cost and schedule benefits through an integrated communications concept. Standard programmable controllers and data-highways are used in a cost effective, high reliability system configuration. The new system design is an outgrowth of work at AECL, over the last several years, on computer control and communication technology, and on the development of industrial data highway standards. The system provides high speed data communications for the existing control computers, replacing the centralized multiplexing and de-multiplexing equipment. The system also replaces the relay logic, timers, comparators, etc., by program logic, using programmable controllers which are integrated into the distributed system. The system is distributed geographically using high speed redundant data highways, to replace a large part of the trunk cabling and interconnection wiring. The system is designed to fit into the existing design with minimum cascading effect on the interfacing devices. This paper describes the system and discusses some of the key factors which have influenced the system design.

29016 (EPRI-NP—5641-SR, pp 4.6.1-4.6.11) **Use of fiber optics in an emergency response data system.** Mahaffey, J.A.; Wahab, E.Z. (Georgia Institute of Technology, Atlanta (USA)). Feb 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920217/JAW. (CONF-8608110—).

From Seminar on integrated power plant computer communications; San Francisco, CA, USA (25 Aug 1986).

An optical fiber communications medium has been installed in the Emergency Response Data Systems (ERDS) in the E. I. Hatch Nuclear Power Plant. These high-speed, digital communications systems are used to link together two data-collection nodes in each of two computer networks, so that the plant operating data may be shared on a real-time basis. The use of a glass-and-plastic fiber for data communications may have several advantages over a metallic medium in this special application, and it has proven to be a very reliable means of data linkage over several unit-years of operation.

29017 (EPRI-NP—5641-SR, pp 4.7.1-4.7.13) **Communications interface for plant monitoring system.** Lee, K.L.; Morgan, F.A. (Public Serve Electric and Gas Co., Newark, NJ (USA)). Feb 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920217/JAW. (CONF-8608110—).

From Seminar on integrated power plant computer communications; San Francisco, CA, USA (25 Aug 1986).

This paper presents the communications interface for an intelligent color graphic system which PSE & G developed as part of a plant monitoring system. The intelligent graphic system is designed to off-load traditional host functions such as dynamic graphic updates, keyboard handling and alarm display. The distributed system's data and synchronization problems and their solutions are discussed.

29018 (EPRI-NP—5641-SR, pp 5.1.1-5.1.10) **Cost benefit analysis of power plant database integration.** Wilber, B.E.; Cimento, A.; Stuart, R. (Computer Integrated Management Inc., San Francisco, CA (USA)). Feb 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920217/JAW. (CONF-8608110—).

From Seminar on integrated power plant computer communications; San Francisco, CA, USA (25 Aug 1986).

A cost benefit analysis of plant wide data integration allows utility management to evaluate integration and automation benefits from an economic perspective. With this evaluation, the utility can determine both the quantitative and qualitative savings that can be expected from data integration. The cost benefit analysis is then a planning tool which helps the utility to develop a focused long term implementation strategy that will yield significant near term benefits. This paper presents a flexible cost benefit analysis methodology which is both simple to use and yields accurate, verifiable results. Included in this paper is a list of parameters to consider, a procedure for performing the cost savings analysis, and samples of this procedure when applied to a utility. A case study is presented involving a specific utility where this procedure was applied. Their uses of the cost-benefit analysis are also described.

29019 (EPRI-NP—5641-SR, pp 5.2.1-5.2.11) **EPRI computer aided engineering guidelines report.** Thomas, K. (Duke Power Co., Charlotte, NC (USA)). Feb 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920217/JAW. (CONF-8608110—).

From Seminar on integrated power plant computer communications; San Francisco, CA, USA (25 Aug 1986).

Many power plant communications technologies are being employed in plants today in a standalone fashion. A data model of the power plant process is needed to successfully integrate the data requirements of these technologies, particularly in the area of computer-aided engineering (CAE). To address this need, EPRI sponsored project RP 2415-3 to develop a data model of the power plant process, known as the Plant Information Network, and to develop a Guidelines Report to instruct utility staff in using the data model to specify integrated CAE applications. This paper describes the Guidelines Report, its intended usage, and provides an example of usage based on a plant maintenance activity.

29020 (EPRI-NP—5641-SR, pp 5.3.1-5.3.10) **Productivity results of nuclear information systems.** Groves, J.E. (Southern California Edison Co., San Clemente (USA)). Feb 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920217/JAW. (CONF-8608110—).

From Seminar on integrated power plant computer communications; San Francisco, CA, USA (25 Aug 1986).

The information necessary to manage a nuclear generation station and multiple stations is greater today than ever before. The

management of the processes necessary to develop information from data requires professional management and a programmatic approach. The cost is not insignificant. But the cost of not facing this challenge squarely is greater. The San Onofre Nuclear Generation Plant has developed the Nuclear Information Services function to assist management and professionals at all levels with their information needs. Often, this is merely giving them the tools they need to do it themselves. Herein contains a selection of specific examples that urges officer and senior level management to review the concept of the Nuclear Information Services function in more depth to determine the appropriateness of such an approach within their organizations. The establishment of on line computerized systems for the majority of the work flow processes and administrative process has resulted in an estimate 190 less people needed. The Health Physics Automated Access Control System (AACS) implementation resulted in a savings of $800,000 a year. The implementation of a Site Procedures Information Network (SPIN) has saved $160,000 per year.

29021 (EPRI-NP—5641-SR, pp 5.4.1-5.4.7) **Use of action requests to control communications.** Brady, J. (Pacific Gas and Electric Co., Avila Beach, CA (USA)). Feb 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920217/JAW. (CONF-8608110—).

From Seminar on integrated power plant computer communications; San Francisco, CA, USA (25 Aug 1986).

This paper discusses the Plant Information Management System (PIMS) that is implemented at Pacific Gas and Electric Company's (PG and E) Diablo Canyon Power Plant (DCPP). PIMS is implemented on IBM mainframes located at the plant, is on-line and interactive, and is accessed via a computer communication system that supports more than 450 IBM 3270 PC workstations. This paper discusses the role of the ACTION REQUEST module of PIMS and how it is used to control plant sensitive communications. The ACTION REQUEST module of PIMS can be accessed from any workstation and during the first year of Commercial Operation of DCPP replaced numerous and redundant forms of manual communication mechanisms. Also in this first year, users at the plant generated approximately 25,000 Action Requests which were controlled through review and approval cycles by PIMS. Each organization assigned action were immediately notified of their responsibilities so that action could be taken in a timely manner. The Diablo Canyon Power Plant broke Westinghouse world-wide operating records for the first year of operation (over 90% availability) due to a well built and reliable plant and due to a responsive Operations organization, which was well informed and controlled.

29022 (EPRI-NP—5641-SR, pp 5.5.1-5.5.6) **Fast access to plant configuration drawings.** Goedicke, J.A. (Impell Computer Systems, Berkeley, CA (USA)). Feb 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920217/JAW. (CONF-8608110—).

From Seminar on integrated power plant computer communications; San Francisco, CA, USA (25 Aug 1986).

In the design and construction of a nuclear power plant, the Architect-Engineer, Constructor, NSSS vendor, service companies, and other vendors generate over 100,000 engineering drawings which are transferred to the plant owner for storage and maintenance. Plant Engineers actively reference and/or revise many of these drawings to improve plant performance, comply with new regulations, or perform normal plant maintenance. Records Managers are responsible for controlling the drawings and ensuring that they are accessible and up-to-date. This activity may impact some 50,000 drawings during the life of the plant. This paper describes the application of computer-based image technology to convert, control, revise, and access drawings in a plant environment. The description focuses on drawings referenced by plant operators in day-to-day operations, where drawings that reflect the latest plant configuration must be easily and quickly accessible. The application can be extended to cover all drawings referenced and revised during the plant life, and the application is compatible with the emerging technology of optical disk-based storage and retrieval systems.

29023 (EPRI-NP—5641-SR, pp 5.6.1-5.6.14) **POPIT - a computerized support for operational management at Doel power station, Belgium.** Bens, J.; Verschueren, A.; Laperches, C. (EBES, Brussels (Belgium)). Feb 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920217/JAW. (CONF-8608110—).

From Seminar on integrated power plant computer communications; San Francisco, CA, USA (25 Aug 1986).

POPIT is a computerized operational support and management tool for nuclear power stations. It integrates on-line maintenance management with work order and clearance tag scheduling, processing and tracking. It also includes a Technical Specifications supervisor to monitor Limiting Conditions of Operation. The paper describes the major features of POPIT and discusses its impact since implementation at the DOEL nuclear power station in September 1983: increased plant availability, enhanced safety, improved management capabilities.

29024 (EPRI-NP—5641-SR, pp 5.7.1-5.7.14) **Configuration management system applications on plant computers.** Allen, K.; Bowes, E. (Impell Pacific Corp., Portland, OR (USA)). Feb 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920217/JAW. (CONF-8608110—).

From Seminar on integrated power plant computer communications; San Francisco, CA, USA (25 Aug 1986).

The nuclear industry has struggled for years toward the recognized benefits of, and legal requirements for, access to accurate work and equipment history. Today, most nuclear organizations have a Records Management program that is coping with the issue on the borderline of legality. The irony is that the law required effective configuration management because of its safety and control advantages. However, today's generation of configuration management tools attempt primarily to satisfy the law, not to reap the benefits that the law intended. Impell Pacific's expertise lies in designing integrated information technology, document, procedure, and work flows to deliver true configuration management and its advantages to the nuclear industry.

29025 (NUREG/CP—0089, pp 1-2) **Opening remarks.** Haussermann, W. (Swiss Federal Nuclear Safety Inspectorate, Wurenlingen). Dec 1987. NTIS, PC A21/MF A01 - GPO. Order Number TI88900305/JAW. (CONF-8704249—; CSNI—138).

From CSNI specialists meeting on training of nuclear reactor personnel; Orlando, FL, USA (21 Apr 1987).

The goals and approaches of the Nuclear Energy Agency of the Organization for Economic Co-operation and Development are outlined. The work is conducted by permanent and ad hoc working groups and is mostly concerned with reactor operation during accidents or abnormal incidents. Past reactor accidents are analyzed with an emphasis on human factors. The group also studies risk assessment, licensing and safety of the fuel cycle.

29026 (NUREG/CP—0089, pp 3-8) **Remarks by commissioner Kenneth Carr.** Dec 1987. NTIS, PC A21/MF A01 - GPO. Order Number TI88900305/JAW. (CONF-8704249—; CSNI—138).

From CSNI specialists meeting on training of nuclear reactor personnel; Orlando, FL, USA (21 Apr 1987).

Mr. Carr outlines his thoughts on the proper approach to reactor personnel training. The first component is utility management with an appreciation of the complexity of reactor operation and a consequent belief that training is an important part of everyday activity. The second component is a cadre of people who develop, implement and oversee training. The final component is the reactor technician who must have an understanding of the need for training and a desire to learn. In addition emphasis is placed on learning from experience, training as a team, and the benefits of competition.

29027 (NUREG/CP—0089, pp 9-18) **Remarks by Pierre Tanguy.** Dec 1987. NTIS, PC A21/MF A01 - GPO. Order Number TI88900305/JAW. (CONF-8704249—; CSNI—138).

From CSNI specialists meeting on training of nuclear reactor personnel; Orlando, FL, USA (21 Apr 1987).

After a brief review of the safety implications of human performance, especially in accident situations, several aspects of reactor personnel training. These include: safety in training objectives, the need for a safety concious attitude, quality in reactor operation, operator stress, and operator aids.

29028 (NUREG/CP—0089, pp 19-21) **Approaches to training and regulatory practices (I).** Persensky, J.J. (Nuclear Regulatory Commission (USA)). Dec 1987. NTIS, PC A21/MF A01 - GPO. Order Number TI88900305/JAW. (CONF-8704249—; CSNI—138).

From CSNI specialists meeting on training of nuclear reactor personnel; Orlando, FL, USA (21 Apr 1987).

An NEA survey on the analysis, design, development, implementation and evaluation of training for nuclear power plant personnel is discussed. Aspects included are: regulatory basis for training programs, determining the need for training, design of training programs, implementation and, finally evaluation after training.

29029 (NUREG/CP—0089, pp 22-27) **Qualification, training, licensing/authorization and retraining of operating personnel in nuclear power plants. Some requirements and practices commonly shared in the European Community Member States.** Pele, J.P. (Commission of the European Communities, Brussels (Belgium)). Dec 1987. NTIS, PC A21/MF A01 - GPO. Order Number TI88900305/JAW. (CONF-8704249—; CSNI—138).

From CSNI specialists meeting on training of nuclear reactor personnel; Orlando, FL, USA (21 Apr 1987).

At the end of the fifties a treaty was signed instituting between six countries of the European Community for Atomic Energy, or in brief, Euratom. This treaty, in addition to the Common Market Treaty and the Coal and Steel one, constitutes the legal frame of the European Community which, at present, comprises 12 Member States. A commission, the so-called Commission of the European Communities (or in brief CEC) has to implement the provisions laid down in the treaties. Qualification, training, licensing and re-training of operating personnel have been the subjects of an in-depth exchange of views and information in the frame of the work conducted by the Commission. The evaluation of the regulations and practices in countries of the EC and some other countries having a large nuclear energy program, has led to the identification of some generally valid concepts. This synthesis, made with the assistance of a consultant, is now published under the form of an EUR report (EUR 10981). The main topics addressed within this report are the following: shift staffing and staffing of the control room, personnel selection, qualifications necessary for recruitment, training and retraining, and licensing/authorization.

29030 (NUREG/CP—0089, pp 28-32) **NRC methods for evaluation of industry training.** Morisseau, D.S.; Koontz, J.L.; Persensky, J.J. (Nuclear Regulatory Commission, Washington, DC (USA)). Dec 1987. NTIS, PC A21/MF A01 - GPO. Order Number TI88900305/JAW. (CONF-8704249—; CSNI—138).

From CSNI specialists meeting on training of nuclear reactor personnel; Orlando, FL, USA (21 Apr 1987).

On March 20, 1985, the Nuclear Regulatory Commission published the Policy Statement on Training and Qualification. The Policy Statement endorsed the INPO-managed Training Accreditation Program because it encompasses the five elements of performance-based training. This paper described the multiple methods that the NRC is using to monitor industry efforts to improve training and implement the NRC Policy Statement on Training and Qualification. The results of the evaluation of industry training improvement programs will be reviewed by the Commissioners in April 1987 to determine the nature of continuing NRC policy and programs for ensuring effective training for the US nuclear industry.

29031 (NUREG/CP—0089, pp 33-42) **Regulatory requirements and training of reactor operators and senior reactor operators in Spain.** Villajos, P.; Saiz, M.C.; San Antonio, S. (Nuclear Safety Council, Madrid (Spain)). Dec 1987. NTIS, PC A21/MF A01 - GPO. Order Number TI88900305/JAW. (CONF-8704249—; CSNI—138).

From CSNI specialists meeting on training of nuclear reactor personnel; Orlando, FL, USA (21 Apr 1987).

At the CSNI Specialist Meeting on Operator Training and Qualifications, held in Charlotte, NC (USA) in October, 1981, Spain presented a paper entitled Experience Gained in Spain in Licensing Reactor Operators. This paper contained information on the different types of nuclear power plants in operation or under construction in Spain, the generations to which these plants belonged and the Spanish contribution to their design, construction, testing and commercial operation, as well as presenting detailed information on the training and qualification of reactor operators. This presentation is aimed at updating that document, providing fresh data and indicating the changes that have taken place with respect to the applicable criteria and their implementation.

29032 (NUREG/CP—0089, pp 43-51) **Experience gained from the impact of regulation and training measures on shift personnel qualification in the Federal Republic of Germany.** Farber, G.H. (Gesellschaft fur Reaktorsicherheit, Cologne (West Germany)). Dec 1987. NTIS, PC A21/MF A01 - GPO. Order Number TI88900305/JAW. (CONF-8704249—; CSNI—138).

From CSNI specialists meeting on training of nuclear reactor personnel; Orlando, FL, USA (21 Apr 1987).

The shift crews of German nuclear power plants consist of the so-called responsible shift personnel (shift supervisor, deputy shift supervisor, licensed reactor operator), the non-licensed reactor operators and the roundsmen. In accordance with the particularly high qualification requirements, the paper focuses on the responsible shift personnel. The typical training paths for this group of persons are described. Following this, the results of an evaluation of personnel data and examination results are presented. In about 1980-81, the training requirements underwent a material change. This is why the evaluation of the data is restricted to the years from 1982 through 1986. It is the basis of a few conclusions or recommendations regarding the further improvement of personnel qualifications.

29033 (NUREG/CP—0089, pp 52-59) **CEGB approach to the selection and training of nuclear power station personnel within the UK regulatory framework.** Madden, V.J. (Central Electricity Generating Board (England)). Dec 1987. NTIS, PC A21/MF A01 - GPO. Order Number TI88900305/JAW. (CONF-8704249—; CSNI—138).

From CSNI specialists meeting on training of nuclear reactor personnel; Orlando, FL, USA (21 Apr 1987).

This paper considers the approach to the selection and training of engineering, and scientific staff for the Central Electricity Generating Board's (CEGB) Nuclear Power Stations. Formal academic training will have taken place within the State system of education, typically up to the age of at least twenty-one. The CEGB recruits to meet its requirements from those who have successfully completed such programs, some of whom it will have sponsored from the age of eighteen. On recruitment to the CEGB, further structured training programs are utilized to develop the skills and knowledge required to undertake the duties of specific jobs. In the case of Nuclear Power Station staff, account has to be taken of the requirements of the Operating Licence given to the CEGB by the Health and Safety Executive, the regulatory body. This imposes amongst other responsibilities, a requirement of the CEGB to ensure the competency of its Nuclear Power Station staff. The CEGB discharges this through comprehensive training programs designed to meet the requirements of all levels of posts in the various disciplines required to operate a Nuclear Power Station both safely and efficiently.

29034 (NUREG/CP—0089, pp 60-69) **Regulator's view on today's licensed operator training programs.** Grandame, M.F.; Turcotte, G. (Atomic Energy Control Board, Ottawa, Ontario (Canada)). Dec 1987. NTIS, PC A21/MF A01 - GPO. Order Number TI88900305/JAW. (CONF-8704249—; CSNI—138).

From CSNI specialists meeting on training of nuclear reactor personnel; Orlando, FL, USA (21 Apr 1987).

The authors see new and complex challenges for trainers and their managers as nuclear plants strive to improve their licensed operator training programs. As more trainers attempt to apply the Systems Approach to Training (SAT) principles, the lack of available human resources experienced in the application of this process limits its effectiveness. Also, the SAT method does not resolve the needs to know versus the nice to know debate. More use of replica, full scope simulators for training and testing demands a unique type of trainer who is both technically strong, and knowledgeable in simulator testing techniques.

29035 (NUREG/CP—0089, pp 74-83) **Evolution of GPU nuclear's training program.** Long, R.L.; Coe, R.P. (GPU Nuclear Corp., Parsippany, NJ (USA)). Dec 1987. NTIS, PC A21/MF A01 - GPO. Order Number TI88900305/JAW. (CONF-8704249—; CSNI—138).

From CSNI specialists meeting on training of nuclear reactor personnel; Orlando, FL, USA (21 Apr 1987).

GPU Nuclear Corporation (GPUN) manages the operators of Three Mile Island Unit 1 and Oyster Creek Nuclear Generating Stations and the recovery activities at the Three Mile Island Unit 2 plant. From the time it was formed in January 1980 GPUN emphasized the use of behavioral learning objectives as the basis for all its training programs. This paper describes the evolution to a formalized performance based Training System Development (TSD) Process. The Training & Education Department staff increased from 10 in 1979 to the current 120 dedicated professionals, with a corresponding increase in facilities and acquisition of sophisticated Basic Principles Training Simulators and a Three Mile Island Unit 1 control Room Replica Simulator. The impact of these developments and achievement of full INPO accreditation are discussed and related to plant performance improvements.

29036 (NUREG/CP—0089, pp 84-105) **Training program for nuclear power plant personnel.** Sugihara, M.; Ikeda, K.; Shinomiya, Y.; Hada, M. (Ministry of International Trade and Industry, Tokyo (Japan)). Dec 1987. NTIS, PC A21/MF A01 - GPO. Order Number TI88900305/JAW. (CONF-8704249—; CSNI—138).

From CSNI specialists meeting on training of nuclear reactor personnel; Orlando, FL, USA (21 Apr 1987).

Nuclear power generation in Japan reached 24.7% of its electric power supply with its capacity and time availability factors of 76.2% and 77.1%, respectively (in the calendar year 1986 - as of December 31, 1986). One of the reasons for such high performance is attributable to high quality of operating and maintenance personnel in the nuclear power plants. Ministry of International Trade and Industry of the Japanese Government has an overall responsibility with relation to the safety regulations and supervises all scope of training, while the Thermal and Nuclear Power Engineering Society is authorized to conduct licensing activities to qualify the chief shift supervisor of nuclear power plant operation and individual utility companies are required to train their plant operating and maintenance personnel. General status of training for plant personnel is briefly described in this paper, touching the practical education and training systems of utility companies and operation and maintenance training facilities.

29037 (NUREG/CP—0089, pp 106-113) **Manufacturer's part in NPP personnel training in the FRG.** Martin, H.D. (Kraftwerk Union Aktiengesellschaft, Offenbach/Main (West Germany)). Dec 1987. NTIS, PC A21/MF A01 - GPO. Order Number TI88900305/JAW. (CONF-8704249—; CSNI—138).

From CSNI specialists meeting on training of nuclear reactor personnel; Orlando, FL, USA (21 Apr 1987).

This paper describes the regulatory guidelines and the training and retraining procedures and programs for NPP personnel in the Federal Republic of Germany. Reference is also made to the three years dual workshop/factory and classroom education of skilled workers in Germany. KWU as a turnkey manufacturer of Nuclear Power Plants holds the nuclear operating license towards the authority after first fuel loading of a new plant. In this respect it has extensive overall training obligations not only towards its customers but also with regards to its own shift personnel during nuclear power operation up to commercial operation and hand over of the plant. KWU's philosophy of training, its infrastructure, its various obligations and services are described for new plants as well as with regards to retraining for older plants.

29038 (NUREG/CP—0089, pp 114-123) **Impact of regulation of training programs the Belgian approach.** Vandewalle, A. (Vincotte, Brussels (Belgium)). Dec 1987. NTIS, PC A21/MF A01 - GPO. Order Number TI88900305/JAW. (CONF-8704249—; CSNI—138).

From CSNI specialists meeting on training of nuclear reactor personnel; Orlando, FL, USA (21 Apr 1987).

This paper described the Belgian approach related to training programs. After a short description of the situation before the TMI-2 accident, the evolution of training programs will be presented with emphasis on the impact of regulation and requirements set forth by the Belgian regulatory body. The original solution adopted for the use of full-scope simulators will be described. This solution takes into account the design differences between the seven operating nuclear powers plants.

29039 (NUREG/CP—0089, pp 124-136) **Training of nuclear power plant personnel practices in Finland.** Wahlstroem, B.; Reiman, L.; Valkonen, M.; Turpeinen, J. (Technical Research Center of Finland). Dec 1987. NTIS, PC A21/MF A01 - GPO. Order Number TI88900305/JAW. (CONF-8704249—; CSNI—138).

From CSNI specialists meeting on training of nuclear reactor personnel; Orlando, FL, USA (21 Apr 1987).

Four nuclear power units are in commercial operation in Finland. TVO operates two 735 MW BWR units of Swedish design and IVO two 465 PWR units of Soviet design. Good availability figures have been reached during the last five years for all plants. Many different factors have been contributing to the success of nuclear power in Finland. The advanced training of the plant personnel combined with a high educational level of plant personnel is undoubtedly one of the most important factors. Another important factor has been the low turnover rate of the staff at the plant and in the nuclear industry in general. The favorable regulatory climate in Finland with open and trustworthy relations between the power companies and the authorities has also been an important contribution to the success. The paper gives an overview of the training of nuclear power plant personnel as seen from authorities', the power companies' and the research institutions' points of view.

29040 (NUREG/CP—0089, pp 137-144) **Nuclear training and experience feedback in Sweden.** Olofsson, B.G. (Karnkraftsakerhet och Utbildning AB, Stockholm (Sweden)). Dec 1987. NTIS, PC A21/MF A01 - GPO. Order Number TI88900305/JAW. (CONF-8704249—; CSNI—138).

From CSNI specialists meeting on training of nuclear reactor personnel; Orlando, FL, USA (21 Apr 1987).

There are several different ways of educating and training the personnel at the Swedish nuclear power plants: centralized training in full-scale and part-task simulators; centralized education in the form of technical academic courses where computerized teaching is also used; extensive decentralized training out at the nuclear power plants, where compact simulators are also used; and experience feedback forms an important part of the training. Five performance indicators will be identified and the results will be presented. The excellent results are a good indication of the fact that well-executed education and training and smoothly functioning experience feedback give results.

29041 (NUREG/CP—0089, pp 145-152) **Training organization in the Nuclear Generation Division of Electricite De France.** Cordier, B. (Electricite de France, Paris). Dec 1987. NTIS, PC A21/MF A01 - GPO. Order Number TI88900305/JAW. (CONF-8704249—; CSNI—138).

From CSNI specialists meeting on training of nuclear reactor personnel; Orlando, FL, USA (21 Apr 1987).

The training given to nuclear generation staff of the Nuclear and Fossil Generation Division is described. Organization, general principles, instruction methods, resources, an appraisal, and prospects are covered.

29042 (NUREG/CP—0089, pp 153-161) **Current trend in Italy for training operators at ENEL NPP's.** Baldassari, L.; Comini, R.; Noviello, L.; Zanuzzi, C.F. (Ente Nazionale per l'Energia Elettrica, Rome (Italy)). Dec 1987. NTIS, PC A21/MF A01 - GPO. Order Number TI88900305/JAW. (CONF-8704249—; CSNI—138).

From CSNI specialists meeting on training of nuclear reactor personnel; Orlando, FL, USA (21 Apr 1987).

This paper describes actions taken by ENEL in the field of training personnel of Caorso and Alto Lazio NPP's and anticipated future programs for the new NPP of Piemonte-Trino. Full-scope training simulators along with a fossil simulator and a computer aided training system located in the few facility of Piacenza training center are the tools provided to give excellence in training. A systematic approach is going to be implemented in order to rationalize the overall activity.

29043 (NUREG/CP—0089, pp 162-172) **Training, education and qualification of NPP operating personnel in the Netherlands.** de Vrey, G.A. (Ministry of Social Affairs and Employment, Hague (Netherlands)). Dec 1987. NTIS, PC A21/MF A01 - GPO. Order Number TI88900305/JAW. (CONF-8704249—; CSNI—138).

From CSNI specialists meeting on training of nuclear reactor personnel; Orlando, FL, USA (21 Apr 1987).

This paper outlines the organization and the requirements of the training, education and qualification of NPP operating personnel in the Netherlands. It describes the implementation of a formally required scheme of personnel qualification after TMI, and the current practice as developed by the training staff of both Dutch nuclear power plants. Attention is given to the specific circumstances and problems in the Netherlands, and the resulting program. The licensing criteria for control room operating personnel are discussed, including the level of government involvement. Measures are described to improve the approach to training of NPP personnel involved in safety relevant activities. Finally, some ideas are given for strategies to cope with adverse stress situations.

29044 (NUREG/CP—0089, pp 176-185) **Accuracy and updating of training simulators.** Tangy, N. (Electricite de France, Bugey). Dec 1987. NTIS, PC A21/MF A01 - GPO. Order Number TI88900305/JAW. (CONF-8704249—; CSNI—138).

From CSNI specialists meeting on training of nuclear reactor personnel; Orlando, FL, USA (21 Apr 1987).

This report describes the organization taken up by Electricite de France to guarantee and maintain full scope simulators' accuracy to the level required by the training of operators, shift supervisors and engineers. The quality of the simulators is illustrated through two examples of transient: the house load operation and the break of two steam generator tubes in bi-phasic operation.

29045 (NUREG/CP—0089, pp 186-192) **Integrating a simulation facility into a total training experience.** Schaffer, R.E. (PSE & G Nuclear Training Center, Salem, NJ (USA)). Dec 1987. NTIS, PC A21/MF A01 - GPO. Order Number TI88900305/JAW. (CONF-8704249—; CSNI—138).

From CSNI specialists meeting on training of nuclear reactor personnel; Orlando, FL, USA (21 Apr 1987).

This paper deals with the acceptance and use of a nuclear power plant simulator from the training department's perspective. The ultimate users of the device cannot wait until delivery to plan for it implementation in the training process. Planning for use, support, and staffing must proceed in pace with the simulator construction process. This paper will recount some of the experiences and insights acquired during the process of bringing the Salem and Hope Creek simulators on-line and make recommendations on how other utilities, both within the US and in the international scene, can be better prepared to utilize their simulators for the total training experience.

29046 (NUREG/CP—0089, pp 193-203) **Use of simulations in nuclear station field skills training.** Young, M.E. (Ontario Hydro, Tiverton (Canada)). Dec 1987. NTIS, PC A21/MF A01 - GPO. Order Number TI88900305/JAW. (CONF-8704249—; CSNI—138).

From CSNI specialists meeting on training of nuclear reactor personnel; Orlando, FL, USA (21 Apr 1987).

Ontario Hydro's Western Nuclear Training Centre (WNTC) carries the simulation concept of its full-scope control room simulators into its Nuclear Station Skills Training Program for its maintenance staff. The paper will briefly outline Ontario Hydro's approach to Nuclear Maintenance Training and provide examples of how simulated situations are used to train maintenance staff at WNTC.

29047 (NUREG/CP—0089, pp 204-212) **Role of compact on-site simulators in Sweden.** Blomberg, P.E. (Studsvik Energiteknik AB, Nykoping (Sweden)). Dec 1987. NTIS, PC A21/MF A01 - GPO. Order Number TI88900305/JAW. (CONF-8704249—; CSNI—138).

From CSNI specialists meeting on training of nuclear reactor personnel; Orlando, FL, USA (21 Apr 1987).

The scope and methods for nuclear power plant training have, in the past years, been subject to great changes. In addition to the traditional methods of on-site classroom training and replica-simulator training at the training center, the use of STUDSVIK's compact on-site simulators have continuously been increasing in Sweden. The on-site compact simulators are presently used as a regular and indispensable part of the operator training programs for the Forsmark, Oskarshamn and Ringhals nuclear power stations, and the fossil power plant in Stenungsund. Also new staff categories are now subject to simulator training, and this is especially true for the maintenance personnel. New areas of applications have arisen: man/machine interface development and testing, validation of new operator support systems, process analysis and prediction, incident rehearsals and emergency exercises.

29048 (NUREG/CP—0089, pp 213-224) **Training methods and facilities on reactor and simulators at the Grenoble Nuclear Research Centre.** Destot, M.; Siebert, S. (Commissariat a l'Energie Atomique, Grenoble (France)). Dec 1987. NTIS, PC A21/MF A01 - GPO. Order Number TI88900305/JAW. (CONF-8704249—; CSNI—138).

From CSNI specialists meeting on training of nuclear reactor personnel; Orlando, FL, USA (21 Apr 1987).

Siloette is a CEA unit with a threshold vocation: operation of the Siloette 100 KW pool-type research reactor; basic training in reactor physics for nuclear power plant operators; and production of nuclear power plant simulators: PWR, GCR and more generally of all types of industrial unit simulators, thermal power plant, network, chemical plant, etc. From this experience, they would emphasize in particular the synergy arising from these complementary activities, the essential role of training in basic principles as a complement to operation training, and the ever-increasing importance of design ergonomics of the training means.

29049 (NUREG/CP—0089, pp 225-237) **Artificial intelligence and training of nuclear reactor personnel.** Uhrig, R.E.; Buenaflor, M.T. (Univ. of Tennessee, Knoxville (USA)). Dec 1987. NTIS, PC A21/MF A01 - GPO. Order Number TI88900305/JAW. (CONF-8704249—; CSNI—138).

From CSNI specialists meeting on training of nuclear reactor personnel; Orlando, FL, USA (21 Apr 1987).

Expert computer systems offer an excellent and effective means to reduce the potential for operator error, and improve plant safety and reliability. For the training field the benefits are twofold. First, the inclusion of advisory expert systems in the control environments (the physical control room and its simulator) offer a continuous source of on-the-job diagnostic training. Second, expert systems specifically designed for training are feasible for specialized license/requalification training in higher order analytical skills. This paper consists of two parts. In the first section, the improvements

for on-the-job training are examined. In the second section, the benefits for the overall training program are explored in terms of technical and educational rationales.

29050 (NUREG/CP—0089, pp 238-248) **Enhanced learning through scale models and see-thru visualization.** Kelley, M.D. (PowerSafety International, Lynchburg, VA (USA)). Dec 1987. NTIS, PC A21/MF A01 - GPO. Order Number TI88900305/JAW. (CONF-8704249—; CSNI—138).

From CSNI specialists meeting on training of nuclear reactor personnel; Orlando, FL, USA (21 Apr 1987).

The development of PowerSafety International's See-Thru Power Plant has provided the nuclear industry with a bridge that can span the gap between the part-task simulator and the full-scope, high-fidelity plant simulator. The principle behind the See-Thru Power Plant is to provide the use of sensory experience in nuclear training programs. The See-Thru Power Plant is a scaled down, fully functioning model of a commercial nuclear power plant, equipped with a primary system, secondary system, and control console. The major components are constructed of glass, thus permitting visual conceptualization of a working nuclear power plant.

29051 (NUREG/CP—0089, pp 249-258) **Instructional approach to increase trainee learning through improved laboratory/simulated exercises.** Salas, J.R.; Oxford-Grigg, J. (Duke Power Co., Charlotte, NC (USA)). Dec 1987. NTIS, PC A21/MF A01 - GPO. Order Number TI88900305/JAW. (CONF-8704249—; CSNI—138).

From CSNI specialists meeting on training of nuclear reactor personnel; Orlando, FL, USA (21 Apr 1987).

An area that deserves careful attention is the development and the implementation of training to prepare instructors who deliver laboratory/simulated exercises. Techniques are discussed for presenting a one day workshop to prepare instructors to conduct labs. Specific guidelines are outlined for planning a laboratory experience, preparing the training laboratory, conducting the laboratory and evaluating results and providing feedback to trainees.

29052 (NUREG/CP—0089, pp 263-275) **Integrated initial training program for a CEGB operations engineer.** Tompsett, P.A. (Central Electricity Generating Board, Thornberry (England)). Dec 1987. NTIS, PC A21/MF A01 - GPO. Order Number TI88900305/JAW. (CONF-8704249—; CSNI—138).

From CSNI specialists meeting on training of nuclear reactor personnel; Orlando, FL, USA (21 Apr 1987).

This paper considers the overall training programs undertaken by a newly appointed Operations Engineer at one of the Central Electricity Generating Board's (CEGB) Advanced Gas Cooled Reactor (AGR) nuclear power stations. The training program is designed to equip him with the skills and knowledge necessary for him to discharge his duties safely and effectively. In order to assist the learning process and achieve and integrated program, aspects of reactor technology and operation, initially the subject of theoretical presentations at the CEGB's Nuclear Power Training Center (NPTC) are reinforced by either simulation and/or practical experience on site. In the later stages plant-specific simulators, operated by trained tutors, are incorporated into the training program to provide the trainee with practical experience of plant operation. The trainee's performance is assessed throughout the program to provide feedback to the trainee, the trainers and station management.

29053 (NUREG/CP—0089, pp 276-286) **Centrally coordinated maintenance training & qualification program for a multi-unit utility.** Pate, M.C. Jr. (Carolina Power & Light Co., New Hill, NC (USA)). Dec 1987. NTIS, PC A21/MF A01 - GPO. Order Number TI88900305/JAW. (CONF-8704249—; CSNI—138).

From CSNI specialists meeting on training of nuclear reactor personnel; Orlando, FL, USA (21 Apr 1987).

Carolina Power & Light Company (CP & L) operates fossil, hydro, and nuclear generating plants. Included are three nuclear plant sites - two sites are single-unit pressurized water reactors and one site is a two-unit boiling water reactor. A centrally coordinated five-year, five-level Training & Qualification Program is conducted for nuclear plant mechanics, instrumentation and control technicians, and electricians. This program consists of five levels of generic training conducted at a central training facility, five levels of site-specific training, and five levels of employee qualification based on a qualification card system. This program has obtained INPO accreditation.

29054 (NUREG/CP—0089, pp 287-293) **Computer-assisted training for diagnosis and incident situations.** Cordier, B. (Electricite de France, Paris). Dec 1987. NTIS, PC A21/MF A01 - GPO. Order Number TI88900305/JAW. (CONF-8704249—; CSNI—138).

From CSNI specialists meeting on training of nuclear reactor personnel; Orlando, FL, USA (21 Apr 1987).

A discussion Computer-Assisted Training (CAT) and of its place in training the staff of nuclear power stations is made. Resources used, objectives, courses now being developed, assessment, and the growth prospects are considered.

29055 (NUREG/CP—0089, pp 294-305) **Virginia Power's computer-based interactive videodisc training: a prototype for the future.** Seigler, G.G.; Adams, R.H. (Virginia Power, Richmond (USA)). Dec 1987. NTIS, PC A21/MF A01 - GPO. Order Number TI88900305/JAW. (CONF-8704249—; CSNI—138).

From CSNI specialists meeting on training of nuclear reactor personnel; Orlando, FL, USA (21 Apr 1987).

Virginia Power has developed a system and internally produced a prototype for computer-based interactive videodisc (CBIV) training. Two programs have been developed using the CBIV instructional methodology: Fire Team Retraining and General Employee Training (practical factors). In addition, the company developed a related program for conducting a videodisc tour of their nuclear power stations using a videodisc information management system (VIMS).

29056 (NUREG/CP—0089, pp 306-322) **Development of a training assurance program.** Palchinsky, J.; Waylett, W.J. Jr. (Florida Power and Light Co., Juno Beach (USA)). Dec 1987. NTIS, PC A21/MF A01 - GPO. Order Number TI88900305/JAW. (CONF-8704249—; CSNI—138).

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The nuclear industry has made a significant commitment to improve training through the implementation of accredited performance-based training programs. Senior management expects that human performance will improve as a result of significant resource allocations. How do they know if training is effective in achieving improved human performance? Florida Power and Light Company is developing a Training Assurance Program to track indicators of training performance and future trends. Integrating the company's Quality Improvement Program processes with systematic training processes is resulting in personnel functioning in a proactive mode and increased customer satisfaction with training performance.

29057 (NUREG/CP—0089, pp 323-326) **Studies in training nuclear plant personnel.** Hamlin, K.W. (Institute of Nuclear Power Operations, Atlanta, GA (USA)). Dec 1987. NTIS, PC A21/MF A01 - GPO. Order Number TI88900305/JAW. (CONF-8704249—; CSNI—138).

From CSNI specialists meeting on training of nuclear reactor personnel; Orlando, FL, USA (21 Apr 1987).

One of the lessons learned from the Three Mile Island (TMI) accident was that the nuclear industry was ineffective in learning from previous events at other plants. As training programs and methods have improved since TMI, the nuclear industry has searched for effective methods to teach the lessons learned from industry events. The case study method has great potential as a solution. By reviewing actual plant events in detail, trainees can be challenged with solving actual problems. When used in a seminar or discussion format, these case studies also help trainees compare their decision-making processes with other trainees, the instructor, and the personnel involved in the actual case study event.

29058 (NUREG/CP—0089, pp 327-335) **Training of OJT instructors.** Wiggin, N.A. (New Hampshire Yankee, Seabrook (USA)). Dec 1987. NTIS, PC A21/MF A01 - GPO. Order Number TI88900305/JAW. (CONF-8704249—; CSNI—138).

From CSNI specialists meeting on training of nuclear reactor personnel; Orlando, FL, USA (21 Apr 1987).

OJT (on-the-job) instructor training needs to include several important elements. They need to provide OJT instructors with the policies and procedures for conducting and documenting the training; they need to acquaint them with performance objectives and train them to measure performance against these objectives; but most of all they need to teach them how to demonstrate a manipulative skill at the level of the objective, for this is the most likely single teaching method that the OJT instructor will use. This teaching skill consists of several discrete elements, all of which can be taught and learned. Finally, the OJT instructor needs to know how to create a job performance measure to assess the achievement of the learners. This paper describes such a training program.

29059 (NUREG/CP—0089, pp 340-347) **Role of check operators in achieving operational excellence at Virginia Power's nuclear stations.** Shriver, B.L.; Williams, T.M.; Stewart, W.L. (Virginia Power, Richmond (USA)). Dec 1987. NTIS, PC A21/MF A01 - GPO. Order Number TI88900305/JAW. (CONF-8704249—; CSNI—138).

From CSNI specialists meeting on training of nuclear reactor personnel; Orlando, FL, USA (21 Apr 1987).

Virginia Power has implemented a Check Operator Program as a part of its commitment to excellence in the operation of the North Anna and Surry nuclear power stations. The Check Operator Program utilizes highly qualified licensed personnel to independently evaluate the performance of licensed operators and senior operators during normal, abnormal and simulated emergency conditions. Emphasis is placed upon individual and team performance as well as the procedures and training which support the operators. The check operators report to line management to ensure that their recommendations are implemented into the overall operations philosophy of the power station.

29060 (NUREG/CP—0089, pp 348-356) **Influence of operation incidents on the French training program.** Cernes, A. (Centre d'Etudes Nucleaires de Fontenay-aux-Roses (France)). Dec 1987. NTIS, PC A21/MF A01 - GPO. Order Number TI88900305/JAW. (CONF-8704249—; CSNI—138).

From CSNI specialists meeting on training of nuclear reactor personnel; Orlando, FL, USA (21 Apr 1987).

The French electricity producer, Electricite de France (EDF), and the Safety Authorities have developed, each of his own, a procedure for analyzing the operating incidents. One of the major lessons of their analysis was the importance of incidents due to human error and, among them, to deficiencies in the training of the operators. It is, in consequence, particularly important to improve the quality of these programs and one of the major concerns is how to take into account the lessons of operation experience. Their purpose is aimed at describing how this is now done.

29061 (NUREG/CP—0089, pp 357-368) **Closing the loop: using the emergency preparedness exercise for self-evaluation and performance enhancement.** Jamison, J.D.; Moeller, M.P.; Martin, G.F. (Pacific Northwest Lab., Richland, WA (USA)). Dec 1987. NTIS, PC A21/MF A01 - GPO. Order Number TI88900305/JAW. (CONF-8704249—; CSNI—138).

From CSNI specialists meeting on training of nuclear reactor personnel; Orlando, FL, USA (21 Apr 1987).

Large scale reactor emergency drills and exercises provide an unequaled opportunity to identify weaknesses in personnel performance and in emergency preparedness programs. Experience indicates that certain factors are associated with consistently exceptional response capabilities, while other factors are linked to continuing mediocre performance. This paper discusses the emergency preparedness exercise as an element of the training process and examines some of the factors that contribute to success.

29062 (NUREG/CP—0089, pp 369-375) **Improving operator training and performance through simulator observations.** Flynn, J.P. (Institute of Nuclear Power Operations, Atlanta, GA (USA)). Dec 1987. NTIS, PC A21/MF A01 - GPO. Order Number TI88900305/JAW. (CONF-8704249—; CSNI—138).

From CSNI specialists meeting on training of nuclear reactor personnel; Orlando, FL, USA (21 Apr 1987).

This paper describes the methods and results of INPO observations of simulator training for licensed operators. It discusses the history of the observation program to the present. Effective methods for conducting and documenting simulator observations are discussed. The methods used to analyze the observations is also discussed. The major conclusion of the analysis is that opportunities exist for improvement in the use of emergency operating procedures. Teamwork, communication, and simulator instructor skills are also areas where improvement could be made.

29063 (NUREG/CP—0089, pp 376-381) **Selection - factors and influences on training.** Bruno, R.J.; Mascitti, A.P. (Wisconsin Electric Power Co., Milwaukee (USA)). Dec 1987. NTIS, PC A21/MF A01 - GPO. Order Number TI88900305/JAW. (CONF-8704249—; CSNI—138).

From CSNI specialists meeting on training of nuclear reactor personnel; Orlando, FL, USA (21 Apr 1987).

Personnel performance is certainly the goal of training programs and the impact of personnel performance on plant performance indicators is well known. This presentation discusses the selection of personnel prior to training and emphasizes the need for selection criteria to include aptitude intelligence, mechanical ability, work ethic, and emotional stability. Selected data is presented from Point Beach that support a rigorous selection and screening program to ensure training successfully prepared these personnel for job assignments.

29064 (NUREG/CP—0089, pp 382-389) **Determination of the simulator needs for the Belgian nuclear power plants.** Canart, J.; Selleslagh, E. (Intercom S.A., Tihange (Belgium)). Dec 1987. NTIS, PC A21/MF A01 - GPO. Order Number TI88900305/JAW. (CONF-8704249—; CSNI—138).

From CSNI specialists meeting on training of nuclear reactor personnel; Orlando, FL, USA (21 Apr 1987).

Belgium has seven nuclear units in operation on two sites (Doe): twin units 1 and 2: 2 x 400 MW(e) Westinghouse 2 loop, unit 3: 900 MW(e) Framatome and unit 4: 1000 MW(e) Westinghouse, both 3 loop; Tihange: units 1 and 2: 900 MW(e) Framatome, unit 3: 1000 MW(e) Westinghouse, all 3 loop, operated by two different utilities employing operators speaking different languages. The OL's for the four latter units, dated in the '80's, and the ten-yearly revision of the 3 older units' OL, require a simulator in Belgium before a certain deadline. It was decided in common to build two full-scope simulators (Doel 4 and Tihange 2), enlarged to include training on Doel 3 and Tihange 3 bunker systems, and a partial scope simulator for Doel 1-2; an existing compact simulator for Tihange 1 continues to be used for various purposes. The rationale is explained in detail.

29065 (NUREG/CP—0089, pp 390-399) **Evaluating performance measures to determine training effectiveness.** Feiza, A.S.; Klemm, R.W. (Commonwealth Edison Co., Chicago, IL (USA)). Dec 1987. NTIS, PC A21/MF A01 - GPO. Order Number TI88900305/JAW. (CONF-8704249—; CSNI—138).

From CSNI specialists meeting on training of nuclear reactor personnel; Orlando, FL, USA (21 Apr 1987).

This study responded to the Utility Industry's need to relate training benefits with corporate objectives - generating megawatts safely and efficiently. Trained and non-trained employees from nuclear and fossil generating stations were rated by their supervisors on six performance skills themes. Results favored the trained group in all cases. Summary statistics and additional variables were discussed.

29066 (NUREG/CP—0089, pp 400-405) **Model for behavior observation training programs.** Berghausen, P.E. Jr. (Behaviordyne Psychological Corp., Palo Alto, CA (USA)). Dec 1987. NTIS, PC A21/MF A01 - GPO. Order Number TI88900305/JAW. (CONF-8704249—; CSNI—138).

From CSNI specialists meeting on training of nuclear reactor personnel; Orlando, FL, USA (21 Apr 1987).

Continued behavior observation is mandated by ANSI/ANS 3.3. This paper presents a model for behavior observation training that is in accordance with this standard and the recommendations contained in US NRC publications. The model includes seventeen major topics or activities. Ten of these are discussed: Pretesting of supervisor's knowledge of behavior observation requirements, explanation of the goals of behavior observation programs, why behavior observation training programs are needed (legal and psychological issues), early indicators of emotional instability, use of videotaped interviews to demonstrate significant psychopathology, practice recording behaviors, what to do when unusual behaviors are observed, supervisor rationalizations for noncompliance, when to be especially vigilant, and prevention of emotional instability.

29067 (NUREG/CP—0089, pp 410-414) **Approach to team skills training.** Koontz, J.L.; Roe, M.L.; Gaddy, C.D. (Nuclear Regulatory Commission, Washington, DC (USA)). Dec 1987. NTIS, PC A21/MF A01 - GPO. Order Number TI88900305/JAW. (CONF-8704249—; CSNI—138).

From CSNI specialists meeting on training of nuclear reactor personnel; Orlando, FL, USA (21 Apr 1987).

The US commercial nuclear power industry has recognized the importance of team skills in control room operation. The desire to combine training of team interaction skills, like communications, with technical knowledge of reactor operations requires a unique approach to training. An NRC-sponsored study identified a five-phase approach to team skills training designed to be consistent with the systems approach to training currently endorsed by the NRC Policy Statement on Training and Qualification. This paper describes an approach to team skills training with emphasis on the nuclear power plant control room crew. An approach to team skills training.

29068 (NUREG/CP—0089, pp 415-431) **Training of control room crews in plant disturbance diagnosis. A methodological framework.** Hedegard, J. (Swedish Nuclear Power Inspectorate, Stockholm). Dec 1987. NTIS, PC A21/MF A01 - GPO. Order Number TI88900305/JAW. (CONF-8704249—; CSNI—138).

From CSNI specialists meeting on training of nuclear reactor personnel; Orlando, FL, USA (21 Apr 1987).

The purpose of this paper is to outline and describe the background considerations when developing training in diagnostic search for nuclear power station control room crews. The four main factors in these considerations are discussed: human information processing, diagnostic search, crew coordination during the diagnostic search, and finally training and teaching methods. Together, they constitute the cornerstones for the theoretical foundation of the diagnostic search training. The methodological framework in this paper was tested in practical circumstances during October and November 1986, involving control room crews at a Swedish PWR nuclear power station. A report of the findings during this test will be issued later this year.

29069 (NUREG/CP—0089, pp 432-443) **Pre-license team training at San Onofre Nuclear Generating Station.** Freers, S.M.; Hyman, M. (Southern California Edison Co., San Clemente (USA)). Dec 1987. NTIS, PC A21/MF A01 - GPO. Order Number TI88900305/JAW. (CONF-8704249—; CSNI—138).

From CSNI specialists meeting on training of nuclear reactor personnel; Orlando, FL, USA (21 Apr 1987).

Team Training at San Onofre Nuclear Generating Station (SONGS) Units 2 and 3 has been developed to enhance the performance of station operations personnel. The FACT Training Program (Formality, Attention to Detail, Consistency and Team Effort) is the common denominator for operations team training. Compliance with good operating practices is enhanced by operators working as a team toward the same goal, using the same language, practicing the same operating and communication skills, possessing a clear understanding of individual roles and responsibilities of team members and practicing attention to detail in every task. These elements of effective teamwork are emphasized by the processes and criteria used in the Pre-License Operator Training Program at SONGS.

29070 (NUREG/CP—0089, pp 444-454) **Team building and diagnostic training.** Bulmer, S. (General Electric Co., Morris, IL (USA)). Dec 1987. NTIS, PC A21/MF A01 - GPO. Order Number TI88900305/JAW. (CONF-8704249—; CSNI—138).

From CSNI specialists meeting on training of nuclear reactor personnel; Orlando, FL, USA (21 Apr 1987).

While developing a commercial training program to improve teamwork in control room crews, General Electric's Nuclear Training Services made an important discovery. Traditional training methods for developing teamwork and enhancing diagnostics capabilities are incomplete. Traditional methods generally help, but fail to fulfill the long-term needs of most teams. Teamwork has been treated as a short-term performance problem. Traditional diagnostic training suffers from a similar problem. Too often, it covers only the basic principles of decision-making, ignoring the development of expert diagnostic capabilities. In response to this discovery, they have developed comprehensive training in Team Building and Diagnostics.

29071 (NUREG/CP—0089, pp 455-475) **Experiences and solutions with an integrated modular approach to nuclear emergency preparedness and response training problems.** Liang, R.K.; Weiss, L.S.; Michael, E.J. (Stone & Webster Engineering Corp., New York, NY (USA)). Dec 1987. NTIS, PC A21/MF A01 - GPO. Order Number TI88900305/JAW. (CONF-8704249—; CSNI—138).

From CSNI specialists meeting on training of nuclear reactor personnel; Orlando, FL, USA (21 Apr 1987).

Increasing public concern with nuclear safety after TMI and an escalated level of licensing requirements regarding nuclear emergency preparedness have presented unique challenges to the US utilities in expeditiously setting up effective training programs. This paper summarizes the generic aspects of these challenges, identified the causes, and described solutions derived from experiences at several nuclear power stations in the application of an Integrated Modular Approach to emergency response training. Also described are features of the critical design and implementation elements in this approach, the use of Job Analysis, Test Banks, Qual-Card System, and a Graduated Instruction and Practice Scheme, and the factors that have a significant impact on the schedules and effectiveness of training.

29072 **Determination of the sensitivity volume of a BWR in-core detector.** Haghighat, A. Seattle, WA; Univ. of Washington (1986). 208p. University Microfilms Order No. 87-06,577.

Thesis (Ph. D.).

Reactor noise analysis is used to draw dynamic information while a nuclear reactor is operating at a steady power. By cross correlating the signal fluctuations (i.e. cross power spectral density (CPSD)) of two axially located detectors in a boiling water reactor (BWR), one can evaluate a velocity associated with the propagating noise. In the past several years, attention of several investigators has been devoted to the interpretation of this velocity. Determination of the detector sensitivity volume (i.e. field-of-view (FOV)) is needed because it is important to know if the measured velocity is an average or a localized quantity. By performing a series of 2-group, X-Y, S_4 transport theory calculations, it is concluded that a cell homogeneous model is valid for the prediction of the adjoint function distribution around a line (i.e. infinite in Z) detector. The validity of the cell homogeneous model for the prediction of the adjoint function around a point detector (i.e. a finite detector) is confirmed by performing numerical (2-group, cell and bundle homogeneous, X-Y and X-Y-Z diffusion theory models) and analytical (1-D infinite homogeneous diffusion theory model) calculations. Comparison of the results of the combined method of transport and diffusion theories with the results obtained from diffusion theory, showed that an X-Y-Z cell homogeneous diffusion theory model is sufficient for the prediction of the detector FOV.

2205 Environmental Aspects

REFER ALSO TO CITATION(S) 28900, 29133, 29398, 29700

29073 **(DOE/CH/10334—1) Hallam environmental radiation surveillance.** (Nebraska Univ., Lincoln (USA)). [1988]. Contract AP02-87CH10334. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006796/JAW.

An environmental surveillance report is presented for decommissioned Hallam power plant. Statistical analysis shows that the spring data mean is significantly greater than the fall data mean for all water sources. The spring variation is also significantly greater than the fall variation. The water sources demonstrate homogeneity for spring and fall sub-surface sources. Surface water has significantly more radiation than sub-surface water. This may be attributed to increased tritium content in surface water due to atmospheric leaching. Finally, the surface water samples are in close proximity to Sheldon Station, a coal fired plant, and increased coal particulate matter may be increasing the environmental radioactivity. A linear regression model suggests spring readings are decreasing and fall readings significantly increasing from 1975 to 1987. The spring recharge water probably contains natural and man-made radioactivity leached from the atmosphere, as well as natural radioactivity leached from the soil and rocks. The lower mean and less variance for the fall data may better characterize the aquifer. 7 figs.

2206 Research, Test, And Experimental Reactors

REFER ALSO TO CITATION(S) 29004

29074 (DOE/ER/75172—5, pp 13-16) **Down scale of the SP-100 concept for 5 kWe.** Evans, B.; Schueler, W. (Univ. of New Mexico, Albuquerque (USA)). 1987. NTIS, PC A06/MF A01. Order Number DE88005041/JAW. (CONF-8703231—Summs.).

From Western region American Nuclear Society student conference: nuclear technology for the year 2000; Albuquerque, NM, USA (19 Mar 1987).

This paper examines the feasibility of using a SP-100 Thermoelectric space reactor design as a 5 kWe power source, called the SP-5. The SP-100 is scaled down in size to give a high specific power by using the neutronics program FEMP2D. Possible future space missions may require a power source able to provide 5 kWe of power. There is an interest in using nuclear reactors in place of Radioactive Thermoelectric Generators (RTGs) for this low power demand because of the possibility of spreading toxic plutonium by the heat source if there was a launch accident. The SP-5 design will be compared to RTGs on the basis of specific power, safety, and reliability. The reactor studied in this paper is the lithium cooled SP-100. The core was reduced in size by using the neutronics program FEMP2D. A reactor has been designed that is 35 cm high and 15.2 cm in radius. The shield mass is as high as 270 kg and to cool the reactor a radiator with a surface area of 5 square meters (50 kg) is required. This gives a total specific power of 8 We/kg.

29075 (DOE/ER/75172—5, pp 18-22) **5 kWe scale-down of the SPAR/SP-100 Heat Pipe Reactor.** Adrian, J.M.; Benke, S.M. (Univ. of New Mexico, Albuquerque (USA)). 1987. NTIS, PC A06/MF A01. Order Number DE88005041/JAW. (CONF-8703231—Summs.).

From Western region American Nuclear Society student conference: nuclear technology for the year 2000; Albuquerque, NM, USA (19 Mar 1987).

The SPAR/SP-100 Heat Pipe Reactor was designed to operate at 100 kWe. This report presents work done on a 5 kWe scaled-down of the SPAR/SP-100 design. This scale-down was done in order to compare the performance of a small Heat Pipe Reactor to Radioisotope Thermoelectric Generators (RTGs). The work on this design is broken into the following categories: reactor core modeling, control drum modeling, heat rejection modeling, and shadow shield modeling. The reactor core modeling will be completed using the already available computer programs FEMP2D and ORIGEN. FEMP2D will be used to complete the neutronics survey through the core and control drums and it will also be used to ensure the core will be sub-critical in case of a water abort.

29076 (DOE/ER/75172—5, pp 24) **Space reactor assessment and validation study.** Gedeon, S.; Morey, D. (Oregon State Univ., Corvallis (USA)). 1987. NTIS, PC A06/MF A01. Order Number DE88005041/JAW. (CONF-8703231—Summs.).

From Western region American Nuclear Society student conference: nuclear technology for the year 2000; Albuquerque, NM, USA (19 Mar 1987).

The present difficulties experienced by the US in launching payloads into space has suggested a number of problems which are associated with the handling of hazardous materials in spacecraft. The question has arisen as to the safety of launching highly radioactive material such as plutonium-238, related to the possibility of its dispersion into the atmosphere during a launch vehicle explosion. An alternative is the use of a small nuclear reactor which is not started until it is in space and contains little or no radioactivity at launch. Their study entailed a first order assessment of six small reactor concepts with power levels up to 100 MWe. They investigated both the nuclear feasibility of these concepts to operate at their rated power levels between 7 and 10 years and to capability of these concepts to remain subcritical both before and during launch and also in the case of water immersion during a potential launch failure or abort.

2208 Propulsion Reactors

29077 **(EGG-M—41087) Advanced nuclear rocket engine mission analysis.** Ramsthaler, J.; Farbman, G.; Sulmeisters, T.; Buden, D.; Harris, P. (EG and G Idaho, Inc., Idaho Falls (USA); Westinghouse Electric Corp., Madison, PA (USA); Martin Marietta Corp., Englewood, CO (USA); Rockwell International Corp., Canoga Park, CA (USA)). Dec 1987. Contract AC07-76ID01570. 11p. (CONF-871274—1). NTIS, PC A03. Order Number DE88006797/JAW.

From JANNAF propulsion conference; San Diego, CA, USA (15 Dec 1987).

The use of a derivative of the NERVA engine developed from 1955 to 1973 was evluated for potential application to Air Force orbital transfer and maneuvering missions in the time period 1995 to 2020. The NERVA stge was found to have lower life cycle costs (LCC) than an advanced chemical stage for performing low earth orbit (LEO) to geosynchronous orbit (GEO0 missions at any level of activity greater than three missions per year. It had lower life cycle costs than a high performance nuclear electric engine at any level of LEO to GEO mission activity. An examination of all unmanned orbital transfer and maneuvering missions from the Space Transportation Architecture study (STAS 111-3) indicated a LCC advantage for the NERVA stage over the advanced chemical stage of fifteen million dollars. The cost advanced accured from both the orbital transfer and maneuvering missions. Parametric analyses showed that the specific impulse of the NERVA stage and the cost of delivering material to low earth orbit were the most significant factors in the LCC advantage over the chemical stage. Lower development costs and a higher thrust gave the NERVA engine an LCC advantage over the nuclear electric stage. An examination of technical data from the Rover/NERVA program indicated that development of the NERVA stage has a low technical risk, and the potential for high reliability and safe operation. The data indicated the NERVA engine had a great flexibility which would permit a single stage to perform all Air Force missions.

2209 Reactor Safety

REFER ALSO TO CITATION(S) 28988, 29010, 29011, 29012, 29013, 29014, 29015, 29016, 29017, 29018, 29023, 29024, 29365, 29444, 29448

29078 **(BNL-NUREG—40816) Procedures for evaluating technical specifications.** Boccio, J.L.; Robinson, R.C.; Samanta, P.K.; Vesely, W.E. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 12p. (CONF-870973—1).

From Specialist meeting on improving technical specifications for nuclear power plants; Madrid, Spain (7 Sep 1987).

The Procedures for Evaluating Technical Specifications (PETS) Program being conducted by Brookhaven National Laboratory for the Office of Research, US Nuclear Regulatory Commission (NRC), is developing various risk-based approaches for modifying Technical Specifications (TS). This paper highlights the various risk-based issues being addressed by the program and presents examples that exemplify the use of PRA models for modifying TS, primarily elements of the Limiting Condition of Operation (LCOs) and Surveillance Requirements (SRs). PETS approaches to TS modification using more detailed analysis are presented in a companion paper.

29079 **(EGG-M—20187) Application of generic PRA [probabilistic risk assessment] insights to NRC inspection.** Fisher, J.E.; Gregg, R.E.; Hinton, M.F.; Wright, R.E.; Hillman, B.M. (EG and G Idaho, Inc., Idaho Falls (USA); Nuclear Regulatory Commission, King of Prussia, PA (USA). Region I). 1987. Contract AC07-76ID01570. 5p. (CONF-870820—11).

From PSA 87: international topical meeting on probabilistic safety assessment and risk management; Zurich, Switzerland (31 Aug 1987).

The United States Nuclear Regulatory Commission (NRC) has developed a program that uses probabilistic risk assessment (PRA) results to produce plant specific inspection guidelines for use by NRC inspectors. Because only about one-quarter of the operating United States (US) plants have PRAs, a generic methodology has been proposed for the production of inspection guidelines for plants without PRAs. The first application of this proposed generic method was to a plant which has a PRA, so a comparison of the inspection guidance produced by the PRA-based and generic methods could be made. An evaluation of the comparison from that application is provided.

29080 **(EGG-M—21487) SCDAP/RELAP5 applications to RCS [reactor coolant system] natural circulation.** Bayless, P.D. (EG and G Idaho, Inc., Idaho Falls (USA)). 1987. Contract AC07-76ID01570. 9p. (CONF-8710111—42). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88006762/JAW.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

The effects of natural circulation flows in the reactor coolant system during a TMLB' sequence were investigated. Both in-vessel circulation and hot leg countercurrent flow were modeled in the Surry nuclear power plant using the SCDAP/RELAP5 computer code. The transient was analyzed until after fuel rod relocation had begun. The delays in the onset of relocation resulting from the natural circulation flows were not significant compared to SCDAP/RELAP5 calculations without natural circulation modeled, but were large compared to the analyses presented in NUREG-1150. The most significant aspect of the natural circulation flows was the heating of ex-vessel structures. Surge line failure is likely to occur before the vessel is breached by the molten core, while steam generator tube failure is not expected.

29081 **(EGG-M—22287) Containment penetration system (CPS) valve tests under accident loads.** Crapo, H.S. (EG and G Idaho, Inc., Idaho Falls (USA)). 1987. Contract AC07-76ID01570. 16p. (CONF-8710111—38).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

The results of testing typical US nuclear power plant containment piping penetrations during thermal and mechanical loading are presented. Full-sized hardware, including the containment wall penetration, piping, pipe supports, and isolation valves were subjected to thermal and mechanical loads simulating design basis and severe accident events. The effect of the thermal and mechanical loads on valve leakage and operability and the effect on overall system integrity were studied. All containment systems performed well and showed no loss of function as a result of the thermal and mechanical loads.

29082 **(EGG-M—22487) SARA [System Analysis and Risk Assessment]: An NRC risk management tool.** Sattison, M.B.; Robinson, R.C. (EG and G Idaho, Inc., Idaho Falls (USA); Nuclear Regulatory Commission, Washington, DC (USA)). 1987. Contract AC07-76ID01570. 12p. (CONF-8710111—44). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006755/JAW.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

The System Analysis and Risk Assessment (SARA) system is being developed at the Idaho National Engineering Laboratory under the direction and guidance of the Office of Nuclear Regulatory Research. The objective of this project is to provide a personal computer (PC)-based, user-friendly system for the computation and analysis of information on nuclear power plant risk characteristics. The latest released version of SARA (Version 2.0) contains the probabilistic risk assessment (PRA) results from four of the five plants included in the NUREG-1150 study. These plants are: Surry;Peach Bottom;Sequoyah;and Grand Gulf.

29083 **(EGG-M—22987) Phenomena identification and ranking tables (PIRT) for LBLOCA.** Shaw, R.A.; Dimenna, R.A.; Larson, T.K.; Wilson, G.E. (EG and G Idaho, Inc., Idaho Falls (USA)). 1987. Contract AC07-76ID01570. 15p. (CONF-8710111—43). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006756/JAW.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

The US Nuclear Regulatory Commission is sponsoring a program to provide validated reactor safety computer codes with quantified uncertainties. The intent is to quantify the accuracy of the codes for use in best estimate licensing applications. One of the tasks required to complete this program involves the identification and ranking of thermal-hydraulic phenomena that occur during particular accidents. This paper provides detailed tables of phenomena and importance ranks for a PWR LBLOCA. The phenomena were identified and ranked according to perceived impact on peak cladding temperature. Two approaches were used to complete this task. First, a panel of experts identified the physical processes considered to be most important during LBLOCA. A second team of experienced analysts then, in parallel, assembled complete tables of all plausible LBLOCA phenomena, regardless of perceived importance. Each phenomenon was then ranked in importance against every other phenomenon associated with a given component. The results were placed in matrix format and solved for the principal eigenvector. The results as determined by each method are presented in this report.

29084 **(EGG-M—31686) Theoretical and experimental damping values of piping systems at high ductilities.** Ware, A.G. (EG and G Idaho, Inc., Idaho Falls (USA)). 1987. Contract AC07-76ID01570. 10p. (CONF-870636—15).

From 5. national congress on pressure vessels and piping; San Diego, CA, USA (28 Jun 1987).

This paper presents a simplified theoretical explanation and test data for piping system damping during post-yield dynamic behavior. The theoretical frequency and damping variations with material ductility are discussed. The results of high excitation level tests from seven sources are described and correlated on common bases. Starting with 0% of critical damping at a local ductility of 1 (yield strain), damping values of from 30 to 50% of critical are estimated at the time of piping system failure. Since 50% of critical damping corresponds to no dynamic amplification at resonance, it is concluded that the input energy is being continually and completely dissipated by the forcing function changing the plastic dynamic deflection shape, with no dynamic amplification of displacements. An experimental method for consistent estimation of damping values at elastoplastic response levels is recommended.

29085 **(EGG-M—33687) A perspective of PC-based probabilistic risk assessment.** Sattison, M.B.; Rasmuson, D.M.; Robinson, R.C.; Russell, K.D.; Van Siclen, V.S. (EG and G Idaho, Inc., Idaho Falls (USA); Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research). 1987. Contract AC07-76ID01570. 9p. (CONF-871234—14).

From ASME winter meeting; Boston, MA, USA (13 Dec 1987).

Probabilistic risk assessment (PRA) information has been under-utilized in the past due to the large effort required to input the PRA data and the large expense of the computers needed to run PRA codes. The microcomputer-based Integrated Reliability and Risk Analysis System (IRRAS) and the System Analysis and Risk Assessment (SARA) System, under development at the Idaho National Engineering Laboratory, have greatly enhanced the ability of managers to use PRA techniques in their decision-making. IRRAS is a tool that allows an analyst to create, modify, update, and reanalyze a plant PRA to keep the risk assessment current with the plant's configuration and operation. The SARA system is used to perform sensitivity studies on the results of a PRA. This type of analysis can be used to evaluate proposed changes to a plant or its operation. The success of these two software projects demonstrate that risk information can be made readily available to those that need it. This is the first step in the development of a true risk management capability.

29086 **(EPRI-NP—2511-CCM-Vol.5) VIPRE-01: A thermal-hydraulic code for reactor cores:.** Stewart, C.W.; Cuta, J.M. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1988. Contract AC06-76RL01830. 120p. Research Reports Center, Box 50490, Palo Alto, CA 94303; GPO Dep. Order Number DE88006875/JAW.

VIPRE (Versatile Internals and Component Program for Reactors;EPRI) has been developed for nuclear power utility thermal-hydraulic analysis applications. It is designed to help evaluate nuclear reactor core safety limits including minimum departure from nucleate boiling ratio (NDNBR), critical power ratio (CPR), fuel and clad temperatures, and coolant state in normal operation and assumed accident conditions. This volume discusses general and specific considerations in using VIPRE as a thermal-hydraulic analysis tool. Volume 1: Mathematical Modeling, explains the major thermal-hydraulic models and supporting mathematial correlations in detail. Volume 2: Users's Manual, describes the input requirements of the codes in the VIPRE code package. Volume 3: Programmer's Manual, explains the code structure and computer interface. Experimence in running VIPRE is documented in Volume 4: Applications. 25 refs., 31 figs., 7 tabs.

29087 **(INIS-mf—11664) Preliminary study to questions relating to the safety of nuclear power plants A and B at Biblis.** Fischer, B.; Hahn, L.; Rausch, L. (Institut fuer Angewandte Oekologie, Darmstadt (Germany, F.R.). Projektgruppe Reaktorsicherheit). Nov 1985. 102p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88753300/JAW.

Werkstattreihe.; no. 25.

With a view to developing suitable tools for the safety evaluation of reactors A and B at Biblis, the publication compiles all aspects relevant to safety, creates an evaluation frame, and evaluates the aspects relevant to safety by means of this frame of evaluation. According to the composition of the work, the overall subject is split up into the complexes information, acquisition, evaluation of operational experience, probabilistic analyses, comparison with newer PWR type reactors, fulfilling of injunctions, modifications due to disposal problems, and the disposal situation.

29088 **(INIS-mf—11670) Design work to modify the PKL test facility for transient tests. Final report.** Mandl, R.; Schmidt, H.; Kremin, H. (Kraftwerk Union A.G., Erlangen (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). 1986. 202p. (In German). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88753305/JAW.

The PKL test facility was used in 1977-1985 mainly to prove experimentally core coolability during a hypothetical double-ended guillotine break of a primary coolant pipe. This facility is now to be modified so that beside small and large breaks in the primary and secondary circuit steam generator tube rupture and long term transients can be simulated. As a first step a so called 'design phase' was carried out. In this phase the scope of the necessary changes to hardware and a proposal for their implementation was worked out. The following modifications resulting from changed objectives and scaling considerations were proposed: Replacement of the double loop by two single loops with separate steam generators, installation of four active reactor coolant pumps, simulation on both the primary and secondary sides of auxiliary systems, expansion of data acquisition and instrumentation capabilities. This report describes in detail the results of the design phase. With 4 refs., 81 figs..

29089 **(INIS-mf—11671) 2D/3D-project - handling of tasks within the framework of the continuation of the 2D/3D-program. Final report.** Sawitzki, M.; Emmerling, R.; Hertlein, R.; Strobel, R. (Kraftwerk Union A.G., Erlangen (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). 1987. 98p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753306/JAW.

Definition and performance of diverse complex tasks. 1. Comment on the results of calibration tests performed and flow algorithms developed in the USA. Development and recommendations for expansion of calibration testing in the FRG. 2. Compilation and review of input data for GPWR-TRAC and UPTF-TRAC code calculations. 3. Analysis of the results of the GPWR-TRAC code calculation shows that oscillating water plugs form in the hot loops near the location of emergency core coolant injection and travel into the steam generators. In order to reproduce this phenomenon in the UPTF some components and pipes have to be modified and the experimental procedure and mode of operation of the facility have to be investigated. 4. In keeping with the results of Pt. 3, the theoretical basis for a steam generator feedback control system was defined in collaboration with TU Muenchen and 5. the process parameter approach for simulation of actual core behavior was formulated. 6. Collaboration on the preparation of test matrices for UPTF and SCTF III. 7. Provision of eight fuel assembly top end pieces for the Japanese test facility SCTF III. With 13 refs., 52 figs..

29090 **(INIS-mf—11687) 1986 annual report of the Nuclear Engineering Committee (KTA).** (Kerntechnischer Ausschuss (KTA), Koeln (Germany, F.R.)). 1987. 40p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753381/JAW.

In 1986, five new regulations have been issued, and one has been amended. Three new draft regulations have been completed, and three draft amendments. There were three commissions for preparatory reports, and one planned regulation has been terminated upon presentation of the preparatory report. Two procedures for amendment have been initiated, and in the case of three existing regulations a revision has shown that they do not need amendment. Ending 1986, the KTA regulations comprised 61 regulations, 10 drafts, 35 drafts in preparation, and 9 preparatory reports. Further, there were 3 drafts for amendment, and 9 procedures for amendment in progress.

29091 **(INIS-mf—11688) Analysis of the danger potential of H_2CO-combustion in the event of core meltdown. Final report.** Fischer, M.; Wagler, K.; Schwarzott, W.; Reineke, H.H. (Kraftwerk Union A.G., Erlangen (Germany, F.R.); Institut fuer Verfahrenstechnische Anlagen, Seelze (Germany, F.R.)). (Kraftwerk Union A.G., Erlangen (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Kraftwerk Union A.G., Erlangen (Germany, F.R.)). 1987. 172p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88753382/JAW.

Based on an evaluation of the present state of knowledge and the experiments performed, several computing programs for the simulation of H_2CO combustion processes were developed within the scope of this project. Besides the one-compartment-model MOPED, based on the formulation of empirical and phenomenological connections, which was also used later to perform the pressure buildup analyses during various core meltdown (CM) scenarios, these were the first two attempts in respect of a fluid-dynamic description of the combustion processes that also takes the reaction kinetics into account (VERLA code, PISCES code). The analysis of the low (LP) and high (HP) pressure path CM conditions showed that no additional risk arises on the HP path due to potential H_2 combustion. In opposition to this maximum combus-

tion gas fractions of 15% by vol. H_2 and 2.5% by vol. CO with assumption of complete enrichment in the containment result on the LP path. With 37 refs., 3 tabs., 78 figs..

29092 **(NUREG—0797-Suppl.14) Safety evaluation report related to the operation of Comanche Peak Steam Electric Station, Units 1 and 2 (Docket Nos. 50-445 and 50-446).** (Nuclear Regulatory Commission, Washington, DC (USA). Comanche Peak Project Div.). Mar 1988. 170p. NTIS, PC A08/MF A01 - GPO. Order Number TI88900486/JAW.

Supplement 14 to the Safety Evaluation Report related to the operation of the Comanche Peak Stam Electric Station (CPSES), Units 1 and 2 (NUREG-0797), has been prepared by the Office of Special Projects of the US Nuclear Regulatory Commission (NRC). The facility is located in Somerville County, Texas, approximately 40 miles southwest of Fort Worth, Texas. This supplement presents the staff's evaluation of the applicants' Corrective Action Program (CAP0 related to large ans small bore piping and pipe supports. The scope and methodologies for CAP workshop as summarized in revision O to the large and small bore piping project status reports and as detailed in related documents referenced in this evaluation were developed to resolve various design issues raised by the Atomic Safety and Licensing Board (ASLB);the intervenor, Citizens Association for Sound Energy (CASE);the Camanche Peak Response Team (CPRT);SYGNA Energy Services (CYGNA);and the NRC staff. The NRC staff concludes that the CAP workscopes for large and small bore piping provide a comprehensive program for resolving the associated technical concerns identified by the ASLB, CASE, CPRT, CYGNA, and the NRC staff and their implementation ensures that the design of large and small bore piping and pipe supports at CPSES satisfies the applicable requirements of 10 CFR 50.

29093 (NUREG/CP—0091-Vol.1, pp 399-414) **SAND87-2330C: MELPROG analysis of the debris formation experiment DF-1.** Heames, T.J.; Gauntt, R.O. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1988. NTIS, PC A20/MF A01 - GPO. Order Number TI88006850/JAW. (CONF-8710111—Vol.1). Contract AC04-76DP00789.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

The MELPROG code is being developed jointly at Sandia National Laboratories and Los Alamos National Laboratory to provide the US Nuclear Regulatory Commission with an integrated analysis model for light water reactor (LWR) severe fuel damage (SFD) accidents. MELPROG is a mechanistic code, based upon detailed physics models, that will calculate the progression of a core uncovered accident including the multi-dimensional thermal hydraulics, core degradation, loss of geometry, melting of the core rods, debris formation, radionuclide release and transport, attack of the support structure, core slumping, melt-water interactions, and vessel failure. Additionally MELPROG can be coupled to the TRAC code to treat fission product transport and the thermal hydraulics of the reactor coolant system. As part of this development effort, the phenomenological modelling in the code is undergoing extensive assessment. This assessment effort involves comparing the data from experimental programs with code predictions to validate the models used and to identify areas of needed model improvement. An important component of this effort is the assessment of the models used to describe the fuel rod heat-up, melting, and relocation phases of an uncovered accident. The Damaged Fuel (DF) experiments are examples of experiments being performed to address these issues. This paper describes a post-test MELPROG analysis of the first of these tests, DF-1.

29094 (NUREG/CP—0091-Vol.1, pp 415-423) **SCDAP/RELAP5 applications to RCS natural circulation.** Bayless, P.D. (EG & G Idaho, Inc., Idaho Falls (USA)). Feb 1988. NTIS, PC A20/MF A01 - GPO. Order Number TI88006850/JAW. (CONF-8710111—Vol.1). Contract AC07-76ID01570.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

The effects of natural circulation flows in the reactor coolant system during a TMLB' sequence were investigated. Both in-vessel circulation and hot leg countercurrent flow were modeled in the Surry nuclear power plant using the SCDAP/RELAP5 computer code. The transient was analyzed until after fuel rod relocation had begun. The delays in the onset of relocation resulting from the natural circulation flows were not significant compared to SCDAP/RELAP5 calculations without natural circulation modeled, but were large compared to the analyses presented in NUREG-1150. The most significant aspect of the natural circulations flows was the heating of ex-vessel structures. Surge line failure is likely to occur before the vessel is breached by the molten core, while steam generator tube failure is not expected.

29095 (NUREG/CP—0091-Vol.1, pp 425-449) **Current and future LWR severe accident related R and D activities at KfK.** Kuczera, B. (Kernforschungszentrum, Karlsruhe (West Germany)). Feb 1988. NTIS, PC A20/MF A01 - GPO. Order Number TI88006850/JAW. (CONF-8710111—Vol.1).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

A broad spectrum of safety investigations into LWR design basis and core meltdown accidents had been covered by the Nuclear Safety Project (PNS) during the past decade. Since the beginning of 1987, LWR safety research and development (R+D) activities conducted at KfK have been reorganized and are now being coordinated by the LWR Safety Project Group (PRS). The topics further treated under PRS relate mainly to severe accident analysis research, measures of source term mitigation and accident consequence limitation. In a more general sense, these activities should be seen within the framework of probabilistic risk assessment studies being performed in Western Germany and scheduled for the future, respectively. This contribution is a summary of some recent findings, of the present status, and of future prospects of LWR oriented R+D work at KfK.

29096 (NUREG/CP—0091-Vol.1, pp 451-477) **Advanced severe accident response models for BWR application.** Ott, L.J. (Oak Ridge National Lab., TN (USA)). Feb 1988. NTIS, PC A20/MF A01 - GPO. Order Number TI88006850/JAW. (CONF-8710111—Vol.1). Contract AC05-84OR21400.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

Boiling Water Reactors (BWRs) and their primary containments have unique features that must be modeled for best estimate severe accident analysis. The BWRSAT Program at ORNL has developed and incorporated into its calculational code suite several advanced response models for application in BWR severe accident analyses. Major features of these models include representation of (1) heat transfer to all in-core structures, (2) the effect of SRV actuations, (3) structural/steam chemistry effects (4) progressive core structural relocation (including candling), (5) failure of coreplate and formation of debris bed in reactor bottom head, (6) vessel penetration failure, and (7) the time dependent egress of core debris from the vessel. This paper discusses these advanced models and presents the results of calculations utilizing the models for the Station Blackout Severe Accident Sequence at Browns Ferry. 44 references.

29097 (NUREG/CP—0091-Vol.1, pp 7-30) **Swedish nuclear safety program.** Hoegberg, L. (Swedish Nuclear Power Inspectorate, Stockholm). Feb 1988. NTIS, PC A20/MF A01 - GPO. Order Number TI88006850/JAW. (CONF-8710111—Vol.1).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

The primary objectives of the Swedish Reactor Safety Program are summarized. The corresponding safety efforts by the nuclear utilities and the Swedish Nuclear Power Inspectorate (SKI) are described. The program on prevention includes recurrent safety reviews of each plant every eight to ten years (the ASAR program). Plant-specific level 1 PSA:s are required as a part of the ASAR program. The program on accident management and consequence mitigation includes improved protection of weak spots in some containments against direct attach of core melt, additional means of supply water to containment sprays and filtered venting of containments. Installation of appropriate equipment and development of appropriate emergency operating procedures shall be com-

pleted by the end of 1988. Finally, Swedish emergency planning is briefly described.

29098 (NUREG/CP—0091-Vol.1, pp 31-54) **Measures taken to improve the safety of nuclear power plants in the USSR after the Chernobyl accident.** Ponomarev-Stepnoi, N.N. (I. V. Kurchatov Institute of Atomic Energy, Moscow (USSR)). Feb 1988. NTIS, PC A20/MF A01 - GPO. Order Number TI88006850/JAW. (CONF-8710111—Vol.1).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

The Soviet delegation to the IAEA experts' meeting (August 25-29, 1986) presented information on the Chernobyl Nuclear Power Plant accident and its consequences. Using data obtained through August 1, 1986, this information contained the results of an investigation into the causes of the accident as well as a description and preliminary analysis of the effectiveness of the immediate steps taken to limit and eliminate its consequences. Subsequent efforts were channeled in the following directions: (1) Continuing operations to eliminate the accident's consequences including: (a) completing the design and construction of a protective cover (sarcophagus) to reliably protect the environment from radioactivity and the introduction of radioactive matter from the destroyed unit; (b) further decontamination of the Chernobyl Nuclear Power Plant site and inhabited areas within the affected zone; and (c) carrying out required sanitary and medical measures to ensure the safety of the population and to protect their health. (2) Development and implementation of longitudinal studies of the long-term consequences of the accident. (3) Development of introduction of measures to increase the safety of working nuclear power stations. (4) Examination of plans for the future development of the nuclear power industry and prospects for increasing its safety level, including: conceptual development of a new generation of nuclear reactors; and expansion of scientific investigation into all aspects of safety assessment and safety assurance in the nuclear power industry. The present report examines the progress of studies along these lines and the conclusions which have been drawn.

29099 (NUREG/CP—0091-Vol.1, pp 55-61) **Advanced reactor licensing issues.** King, T.L.; Wilson, J.N. Feb 1988. NTIS, PC A20/MF A01 - GPO. Order Number TI88006850/JAW. (CONF-8710111—Vol.1).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

In July 1986 the US Nuclear Regulatory Commission issued a Policy Statement on the Regulation of Advanced Nuclear Power Plants. As part of this policy advanced reactor designers were encouraged to interact with NRC early in the design process to obtain feedback regarding licensing requirements for advanced reactors. Accordingly, the staff has been interacting with the Department of Energy (DOE) and its contractors on the review of three advanced reactor conceptual designs: one modular High Temperature Gas-Cooled Reactor (MHTGR) and two Liquid Metal Reactors (LMRs). As a result of these interactions certain safety issues associated with these advanced reactor designs have been identified as key to the licensability of the designs as proposed by DOE. The major issues in this regard are: (1) selection and treatment of accident scenarios; (2) selection of siting source term; (3) performance and reliability of reactor shutdown and decay heat removal systems; (4) need for conventional containment; (5) need for conventional emergency evacuation; (6) role of the operator; (7) treatment of balance of plant; and (8) modular approach. This paper provides a status of the NRC review effort, describes the above issues in more detail and provides the current status and approach to the development of licensing guidance on each.

29100 (NUREG/CP—0091-Vol.1, pp 63-71) **Review of the uncertainty methodology in NUREG-1150 (draft).** Kouts, H.J.; Rasmussen, N.C. Feb 1988. NTIS, PC A20/MF A01 - GPO. Order Number TI88006850/JAW. (CONF-8710111—Vol.1).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

NUREG-1150 is the product of a substantial advance in the art of probabilistic risk assessment. It introduces more up-to-date understanding. It has made a serious attempt to deal with the sources and the implications of uncertainty. It makes use of advanced statistical techniques. The work to date includes several factors that raise questions as to the estimated uncertainties that are presented. These are in areas of selection of experts, the degree to which opinion substituted for expert finding in polling of experts, the mode of display of results, and the quality assurance of the PRA codes and their use. These questions apply not only to the uncertainty bands on risk, but also to any conclusions that might be reached on central values of distribution functions. They undermine the reliability of the numerical results of NUREG-1150.

29101 (NUREG/CP—0091-Vol.1, pp 73-83) **SAND87-1898C: improvements to the original NUREG-1150 accident sequence analyses.** Cramond, W.R.; Camp, A.L. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1988. NTIS, PC A20/MF A01 - GPO. Order Number TI88006850/JAW. (CONF-8710111—Vol.1). Contract AC04-76DP00789.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

Since the accident sequence analyses to support the draft NUREG-1150 were published (NUREG/CR-4550), comments have been received from the utilities, the Nuclear Regulatory Commission, the nuclear industry, and the public. It is the intent to incorporate comments to the extent possible, along with anticipated changes produced by the analysis teams. The purpose of this paper is to identify the important comments and issues that will be addressed for each plant during the reanalysis. There are a few general changes in the methodology that apply to all of the plants. The most important change is an improved uncertainty analysis, including a more comprehensive treatment of uncertainty issues and a more defensible approach to eliciting expert opinion on these issues. Another important change is the addition of external events to the analysis of the Surry and Peach Bottom plants. These and other changes are discussed in this paper.

29102 (NUREG/CP—0091-Vol.1, pp 85-95) **SAND87-2061C: revised accident progression and risk analyses for NUREG-1150.** Gorham-Bergeron, E.D.; Haskin, F.E.; Hora, S.C. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1988. NTIS, PC A20/MF A01 - GPO. Order Number TI88006850/JAW. (CONF-8710111—Vol.1).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

Preliminary III PRA analyses that support preparation of the Nuclear Regulatory Commission's Reactor Risk Reference Document (NUREG-1150) have been conducted at Sandia National Laboratories for four plants: Surry, Sequoyah, Peach Bottom and Grand Gulf. Brookhaven National Laboratories conducted the analysis for the Zion plant. Review of the preliminary analyses produced comments and criticisms from two committees (Kouts Committee and Kastenberg Committee), from industry, and from a variety of other sources. As a result, the final analyses currently under way at Sandia and Brookhaven will contain several improvements over the preliminary analyses. Of these the most significant improvement is in the methodology used to elicit expert opinion concerning highly uncertain questions about severe accident phenomena.

29103 (NUREG/CP—0091-Vol.1, pp 97-114) **Use of containment event trees for NUREG-1150.** Breeding, R.J.; Griesmeyer, J.M.; Gregory, J.J.; Murfin, W.B.; Amos, C.N. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1988. NTIS, PC A20/MF A01 - GPO. Order Number TI88006850/JAW. (CONF-8710111—Vol.1). Contract AC04-76DP00789.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

For the analysis of offsite risk for NUREG-1150, containment event trees (CETs) which are extremely large by past standards have been utilized. These CETs allow the processes that take place in the containment to be considered in much more detail than was previously possible. The CETs are evaluated by a computer code, EVNTRE, developed for this purpose. EVNTRE provides a sampling capability which allows uncertainty in the outcome to be calculated by evaluating the CET many times, with different values for the branching ratios and parameters in the CET which are un-

certain. The pathways through the CET are grouped according to several attributes that provide the information required for the calculation of the source term.

29104 (NUREG/CP—0091-Vol.1, pp 115-129) **Calculation of source terms for NUREG-1150.** Breeding, R.J.; Williams, D.C.; Murfin, W.B.; Amos, C.N.; Helton, J.C. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1988. NTIS, PC A20/MF A01 - GPO. Order Number TI88006850/JAW. (CONF-8710111—Vol.1). Contract AC04-76DP00789.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

The source terms estimated for NUREG-1150 are generally based on the Source Term Code Package (STCP), but the actual source term calculations used in computing risk are performed by much smaller codes which are specific to each plant. This was done because the method of estimating the uncertainty in risk for NUREG-1150 requires hundreds of source term calculations for each accident sequence. This is clearly impossible with a large, detailed code like the STCP. The small plant-specific codes are based on simple algorithms and utilize adjustable parameters. The values of the parameters appearing in these codes are derived from the available STCP results. To determine the uncertainty in the estimation of the source terms, these parameters were varied as specified by an expert review group. This method was used to account for the uncertainties in the STCP results and the uncertainties in phenomena not considered by the STCP.

29105 (NUREG/CP—0091-Vol.1, pp 131-149) **Ex-plant consequence assessment for NUREG-1150: models, typical results, uncertainties.** Sprung, J.L. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1988. NTIS, PC A20/MF A01 - GPO. Order Number TI88006850/JAW. (CONF-8710111—Vol.1). Contract AC04-76DP00789.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

The assessment of ex-plant consequences for NUREG-1150 source terms was performed using the MELCOR Accident Consequence Code System (MACCS). This paper briefly discusses the following elements of MACCS consequence calculations: input data, phenomena modeled, computational framework, typical results, controlling phenomena, and uncertainties. Wherever possible, NUREG-1150 results will be used to illustrate the discussion. 28 references.

29106 (NUREG/CP—0091-Vol.1, pp 151-176) **Integration of the NUREG-1150 analyses: calculation of risk and propagation of uncertainties.** Helton, J.C.; Griesmeyer, J.M.; Haskin, F.E.; Iman, R.L.; Amos, C.N.; Murfin, W.B. (Arizona State Univ., Tempe (USA)). Feb 1988. NTIS, PC A20/MF A01 - GPO. Order Number TI88006850/JAW. (CONF-8710111—Vol.1). Contract AC04-76DP00789.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

The calculation of risk and the propagation of uncertainties in the US Nuclear Regulatory Commission's reassessment of risk from commercial nuclear power stations (i.e., NUREG-1150) is described. The overall integration of the analysis performed for each nuclear power station considered in NUREG-1150 is based on: (1) relatively fast-running models for the individual parts of the analysis, (2) well-defined interfaces between the individual parts of the analysis, (3) definition of selected issues for uncertainty analysis, (4) use of Monte Carlo procedures in conjunction with an efficient sampling technique (i.e., Latin hypercube sampling) to propagate uncertainties, and (5) automation of the overall analysis. The preceding approach is described and then illustrated with the analysis performed for the Peach Bottom nuclear power station. 56 references.

29107 (NUREG/CP—0091-Vol.1, pp 177-185) **SAND87-2064C: the level 3 probabilistic risk assessment of LaSalle Unit 2.** Payne, A.C. Jr. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1988. NTIS, PC A20/MF A01 - GPO. Order Number TI88006850/JAW. (CONF-8710111—Vol.1). Contract AC04-76DP00789.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

Under contract to the US Nuclear Regulatory Commission, Sandia National Laboratories (SNL) is performing a state-of-the-art Level 3 Probabilistic risk Analysis of LaSalle Unit 2, a BWR5 with a Mark II containment. Results obtained to date from the Level 1 internal, fire, flood, and seismic analyses indicate the characteristics of dominant accident sequences and reveal distinct advantages to the integrated systems-analysis approach being employed. The extension of an integrated methodology to the accident progression, source term and consequence analyses will permit a quantitative treatment of uncertainties in Level 3 risk measures arising from all stages of the PRA. A simplified version of these methods has been adopted for the NUREG-1150 PRAs.

29108 (NUREG/CP—0091-Vol.1, pp 187-193) **Reanalysis of Zion risk.** Park, C.K.; Unwin, S.D.; Cazzoli, E.; Tingle, A.; Chun, M. Feb 1988. NTIS, PC A20/MF A01 - GPO. Order Number TI88006850/JAW. (CONF-8710111—Vol.1).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

As part of the NUREG-1150 effort, Brookhaven National Laboratory (BNL) has undertaken a risk analysis of Zion Unit 1 adopting the methodology developed at Sandia National Laboratories (SNL) under the Severe Accident Risk Rebaselining Program. Resulting of the preliminary version of that analysis are reported here. Completion plans for the Zion study are described also.

29109 (NUREG/CP—0091-Vol.1, pp 195-206) **SARA - an NRC risk management tool.** Sattison, M.B.; Robinson, R.C. (EG & G Idaho, Inc., Idaho Falls (USA)). Feb 1988. NTIS, PC A20/MF A01 - GPO. Order Number TI88006850/JAW. (CONF-8710111—Vol.1). Contract AC07-76ID01570.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

The System Analysis and Risk Assessment (SARA) system is being developed at the Idaho National Engineering Laboratory. The objective of this project is to provide a personal computer-based, user-friendly system for the computation and analysis of information on nuclear power plant risk characteristics. The latest released version of SARA (Version 2.0) contains the probabilistic risk assessment (PRA) results from four of the five plants included in the NUREG-1150 study. These plants are Surry, Peach Bottom, Sequoyah, and Grand Gulf. The SARA system is an interactive program that allows the user to temporarily modify initiating event and/or basic event frequencies and propagate those changes through the plant model to determine their impact on the core melt frequency. The results of the reanalysis (or sensitivity study) are displayed alongside the original PRA (base case) results. Base case and sensitivity study importance measures for basic events, cutsets, and sequences, and PDSs are calculated at any level as dictated by the user. The importance measures include the Fussel-Vesely importance, the risk-reduction ratio, the risk-achievement ratio, and the Birnbaum importance. The SARA data base has the ability to store and manipulate the data for a large number of plants. This ability has been exploited such that a group of plants as designated by the user can be analyzed at the same time. This feature allows the user to evaluate multi-plant actions and generic issues with respect to industry risk. The results display shows individual plant impacts and changes in the group values.

29110 (NUREG/CP—0091-Vol.1, pp 207-215) **Methodology for evaluation of multi plant actions.** Cathey, N.G.; VanderMolen, H.; Galyean, W.J. (EG & G Idaho Inc., Idaho Falls (USA)). Feb 1988. NTIS, PC A20/MF A01 - GPO. Order Number TI88006850/JAW. (CONF-8710111—Vol.1). Contract AC07-76ID01570.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

A methodology has been developed for the evaluation of Multi Plant Action (MPA) issues. The methodology employed to evaluate the impact of an MPA provides a systematic way to: understand the issue, identify the effect on the specific plant being examined and finally, evaluate the impact on risk. Although the de-

tails required to evaluate specific MPA issues will vary, the basic methodology can be applied to all issues. This paper presents the methodology employed, and results of, the evaluation of several MPAs at three plants (Surry, a BWR/4, and a 3-loop Westinghouse PWR). The results presented should be regarded primarily as a demonstration of the methodology and the feasibility of using the Systems Analysis and Risk Assessment (SARA) and Integrated Reliability and Risk Analysis System (IRRAS) PC-based Probabilistic Risk Assessment (PRA) tools.

29111 (NUREG/CP—0091-Vol.1, pp 217-236) **Overview of the NRC/EPRI common cause analysis framework.** Rasmuson, D.M.; Worledge, D.H.; Mosleh, A.; Fleming, K.; Parry, G.W.; Paula, H. Feb 1988. NTIS, PC A20/MF A01 - GPO. Order Number TI88006850/JAW. (CONF-8710111—Vol.1).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

This paper presents an overview of a framework for the inclusion of the impact of common cause failures in risk and reliability evaluations. Common cause failures are defined as that subset of dependent failures whose causes are not explicitly included in the logic model as basic events. The emphasis here is on providing guidelines for a practical, systematic approach that can be used to perform and clearly document the analysis. The framework comprises four major stages: (1) Logic Model Development, (2) Identification of Common Cause Component Groups, (3) Common Cause Modeling and Data Analysis, and (4) Quantification and Interpretation of Results. The framework and the methods discussed for performing the different stages of the analysis integrate insights obtained from engineering assessments of the system and the historical evidence from multiple failure events into a systematic, reproducible, and defensible analysis. 25 references.

29112 (NUREG/CP—0091-Vol.1, pp 237-247) **IRRAS - version 2.0.** Russell, K.D.; Sattison, M.B.; Rasmuson, D. (EG & G Idaho, Inc., Idaho Falls (USA)). Feb 1988. NTIS, PC A20/MF A01 - GPO. Order Number TI88006850/JAW. (CONF-8710111—Vol.1). Contract AC07-76ID01570.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

The Integrated Reliability and Risk Analysis System (IRRAS) is being developed as the state-of-the-art microcomputer-based probabilistic risk assessment (PRA) model development and analysis tool to address key nuclear plant safety issues. IRRAS is an integrated PRA software tool that gives the user the ability to create and analyze fault trees and accident sequences using an IBM-PC. This program provides functions that range from graphical fault tree construction to cut set generation and quantification. Also provided in the system is an integrated full-screen editor for use when interfacing with remote mainframe computer systems. Version 1.0 of the IRRAS program contained many of the basic features needed for fault tree analysis and was received very well by the PRA community. Since the release of Version 1.0, many user comments and enhancements have been incorporated into the program providing a much more powerful and user-friendly system. IRRAS has all the capabilities and functions required to create, modify, reduce, and analyze fault tree models used in the analysis of complex systems and processes. IRRAS uses advanced graphic and analytical techniques to achieve the greatest possible realization of the potential of the microcomputer. When the needs of the user exceed this potential IRRAS can call upon the power of the mainframe computer. Version 2.0 of IRRAS provides all of the same capabilities as Version 1.0 and adds a relational data base facility for managing the data, improved functionality, and improved algorithm performance.

29113 (NUREG/CP—0091-Vol.1, pp 249-262) **Methodology for the evaluation of a boiling water reactor (BWR) level sensing line break and single failure.** Bruske, S.J.; Joyce, J.P. (EG & G Idaho, Inc., Idaho Falls (USA)). Feb 1988. NTIS, PC A20/MF A01 - GPO. Order Number TI88006850/JAW. (CONF-8710111—Vol.1). Contract AC07-76ID01570.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

This paper presents the methodology used to evaluate potential safety concerns related to Boiling Water Reactor level sensing line breaks and additional single failures. These concerns were designated as a Generic Issue by the Nuclear Regulatory Commission and assigned a High Priority in April, 1985. This methodology includes identification of potentially significant scenarios, evaluation of the risk resulting from each scenario and an analysis of risk-reducing plant modifications. The analysis includes calculations performed to estimate the frequency of breaks and single failures occurring and cost estimates for possible plant modifications. A cost-benefit analysis was performed as a final step to evaluate possible resolutions to this Generic Issue.

29114 (NUREG/CP—0091-Vol.1, pp 263-272) **Application of a methodology to determine priorities for nuclear power plant safety issues.** Daling, P.M. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1988. NTIS, PC A20/MF A01 - GPO. Order Number TI88006850/JAW. (CONF-8710111—Vol.1). Contract AC06-76RL01830.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

The Nuclear Regulatory Commission (NRC) Office of Nuclear Regulatory Research (RES) is sponsoring a research program to determine priorities of nuclear power plant safety issues. A methodology has been developed at the Pacific Northwest Laboratory (PNL) to provide technical assistance in the development of risk and cost estimates for implementing resolutions to the safety issues. The information development methods are intended to provide the NRC with a consistent level of information for use in ranking the issues. The NRC uses this information, along with judgmental factors, to rank the issues for further consideration by the NRC staff. The primary purpose of the priority rankings are to assist in the allocation of resources to issues that have high potential for reducing public risk as well as to remove issues from further consideration that have little safety significance.

29115 (NUREG/CP—0091-Vol.1, pp 273-286) **Modular gas reactor lift-off source term: data needs and experimental plans.** Martin, J.L.; Lanning, D.D.; Lidsky, L.M. (Massachusetts Institute of Technology, Cambridge (USA)). Feb 1988. NTIS, PC A20/MF A01 - GPO. Order Number TI88006850/JAW. (CONF-8710111—Vol.1).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

The Modular Gas-cooled Reactor incorporates many features which could make it attractive to US utilities. Foremost among these is enhanced safety, achieved through simplified design and reliance on passive safety features. For the MGR to meet its goal of not requiring public evacuation even during the design basis depressurization accident may require either a reduction in the uncertainty in source term calculations or extremely high fuel quality. A major source of this uncertainty is in the prediction of deposition and lift-off of radioactive contaminants on primary circuit walls. Previous experiments have not produced data which is readily usable for MGR design studies. MIT's DABLE loop seeks to reduce source term uncertainty by studying experimentally the deposition and lift-off of Cs, I, Sr, and Ag under well-characterized conditions typical of a MGR primary circuit.

29116 (NUREG/CP—0091-Vol.1, pp 287-301) **Overview status of US advanced reactor program.** Gavigan, F.X.; Nulton, J.D.; Humphreys, J.R.; Millunzi, A.C. Feb 1988. NTIS, PC A20/MF A01 - GPO. Order Number TI88006850/JAW. (CONF-8710111—Vol.1).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

During the past three years, the Department of Energy has made impressive strides in its program to develop advanced Liquid Metal Cooled Reactor (LMR) and High Temperature Gas-Cooled Reactor (HTGR) reactor concepts. Significant progress was made last year in developing the extremely challenging goals of passive core reactivity control and passive decay heat removal. Core redesign to reduce reactivity swings has reduced rod worths, at power, to 5 to 25 cents, eliminating the major problem of Transient Overpower due to accidental rod withdrawal. Additional thermal hydraulics tests have verified natural circulation calculations for both

primary sodium flow and direct air cooling. Supporting R & D has reduced uncertainties in the emissivity values used in decay heat removal calculations. The passive safety features based on inherent physical phenomena continues to lead to greater plant design simplification and elimination of unnecessary engineered safeguard safety systems. Preliminary Safety Information Documents (PSID's) have been prepared and submitted to the NRC for the Power Reactor Inherently Safe Module (PRISM), the Sodium Advanced Fast Reactor (SAFR), and the Modular High Temperature Gas Reactor (MHTGR). These documents have been the basis for a number of meetings between DOE and its contractors with the NRC staff to discuss and clarify the technical positions defined in the PSID's. To date, no significant technical issues have been identified with challenge the basic licensing feasibility for these advanced concepts. A Safety Evaluation Report (SER) is scheduled for issuance by the NRC in the first quarter 1988 to be followed by a licensability statement for each of the LMR and HTGR designs.

29117 (NUREG/CP—0091-Vol.1, pp 303-308) **Inherent safety and design certification of PRISM.** Brown, N.W.; Dubberley, A.E.; Genetti, B.K.; Gyorey, G.L.; Hunsbedt, A.; Murata, R.E.; Rhow, S.K.; Wu, T.; Fujita, E.K.; Ragland, W.A.; Wigeland, R.A. (General Electric Co., San Jose, CA (USA)). Feb 1988. NTIS, PC A20/MF A01 - GPO. Order Number TI88006850/JAW. (CONF-8710111—Vol.1).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

General Electric Company has introduced an innovative technological approach to reactor design that, when combined with change in US Nuclear Regulatory Commission (NRC) practice, will lead to safe and economically competitive fast breeder reactor electric power plants. The key elements in this approach are characteristics in the reactor that will cause it to passively control reactivity and shutdown and passively cool itself without action by the human operators or active devices that require energy supplies external to the reactor module. These characteristics have been called the inherent features or the inherency of the design. They are inherent because they depend on only the material and geometric properties of the reactor module design. Thermal expansion and deflections as well as temperature dependent nuclear properties, such as the Doppler effect, are examples of inherent behavior. Natural convection due to density differences in fluid coolant paths is another example. These characteristics do not depend on active devices that require external energy supplies. PRISM uses natural circulation cooling for safety grade decay heat removal. Negative reactivity feedback with increasing temperature will balance the power generated with the heat removed. The PRISM also incorporates a factory fabricated containment barrier that encloses the reactor and primary coolant. The reactor module design is being developed so that the inherent characteristics of the reactor module can be tested in a full scale prototype. Results from this testing along with other safety and design information will be used to obtain NRC Design Certification.

29118 (NUREG/CP—0091-Vol.1, pp 317-327) **SAFR: increased safety by capitalizing on the inherent characteristics of liquid-metal reactors.** Lancet, R.T.; Mills, J.C.; Martin, C.B. (Rockwell International, Canoga Park, CA (USA)). Feb 1988. NTIS, PC A20/MF A01 - GPO. Order Number TI88006850/JAW. (CONF-8710111—Vol.1).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

The Sodium Advanced Fast Reactor (SAFR) has been designed to provide a unique level of safety assurance. A defense-in-depth design approach to the accommodation of transients is utilized to protect both plant investment and public safety. A sequential hierarchy of highly reliable engineered systems is used for the initial lines of defense. The ultimate safety protection mode is unique, relying on the inherent response of the SAFR plant to ensure a safe response to all credible events, including postulated accidents without scram. This inherency is made economically possible by such distinct SAFR design characteristics as a pool-type configuration, a metal-fuel core, and natural convection decay heat removal systems. Transient analyses are presented to demonstrate the viability of the SAFR safety approach.

29119 (NUREG/CP—0091-Vol.1, pp 329-336) **Source term code package: modifications and applications.** Gieseke, J.A.; Curtis, L.A.; Cybulskis, P.; Jordan, H.; Kogan, V.; Lee, K.W.; Schumacher, P.M.; Wooton, R.O. (Battelle Columbus Div., OH (USA)). Feb 1988. NTIS, PC A20/MF A01 - GPO. Order Number TI88006850/JAW. (CONF-8710111—Vol.1).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

The Source Term Code Package (STCP) and its development have served a pivotal role in the advancement of source term research by helping to focus both modeling and experimental efforts on issues that are of controlling importance in their ability to predict accident consequences. Currently efforts are continuing with the goal of upgrading various STCP code features. The need for these changes results from the continuing research and growing data base in the area of fission product release and transport. Among the models which are being upgraded are those dealing with direct containment heating, fission product release from the fuel, combined analyses of containment transport, and pool/ice condenser removal, and more direct and adequate coupling of heat transfer and fission product transport in the reactor coolant system.

29120 (NUREG/CP—0091-Vol.1, pp 337-349) **Recent advances in the CONTAIN code.** Bergeron, K.D.; Carroll, D.E.; Gelbard, F.; Murata, K.K.; Valdez, G.D.; Washington, K.E. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1988. NTIS, PC A20/MF A01 - GPO. Order Number TI88006850/JAW. (CONF-8710111—Vol.1). Contract AC04-76DP00789.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

The purpose of this presentation is to provide an update on very recent developments involving CONTAIN, the USNRC's principal mechanistic code for severe accident containment analyses. First the features in two major new releases of CONTAIN are outlined. Revision 1.06 includes full integration of the CORCON and VANESA models for debris concrete interactions and concomitant aerosol generation, more detailed and more flexible radiation heat transfer options, and a number of minor improvements. The most recent new version of the code is CONTAIN 1.1, which was released in October. The principal new features relate to the Boiling Water Reactor, in particular, working models for Pressure Suppression Pools and Safety Relief Valves. In addition, this version has a much-improved treatment of fission product hosting, user-defined material property options, and a number of other improvements. A second major area of progress involves the aerosol models. Numerical diffusion limited the accuracy of the calculation of the concentration of the smallest particles. Also, there was no accounting for the effects of soluble salts or surface tension on the equilibrium water vapor pressure. These problems have now been solved with a stand-alone aerosol modeling code which uses a suite of new numerical approaches. The new methods have been incorporated into CONTAIN. Example calculations are presented. Finally, an important new direction involves the coupling of CONTAIN with MELPROG. Recently, the NRC has decided to develop the capability to run accident sequence calculations in which output from the TRAC/MELPROG in-vessel melt progression code is fed directly into the CONTAIN code for a complete and integrated best-estimate analysis. Initial goals and progress in this program are described.

29121 (NUREG/CP—0091-Vol.1, pp 373-397) **MELCOR in-vessel modeling.** Summers, R.M.; Webb, S.W.; Cole, R.K.; Dingman, S.E. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1988. NTIS, PC A20/MF A01 - GPO. Order Number TI88006850/JAW. (CONF-8710111—Vol.1). Contract AC04-76DP00789.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

MELCOR is a fully integrated computer code that models the progression of severe accidents in LWR nuclear power plants. MELCOR is being developed at Sandia for the USNRC as the successor to the Source Term Code Package. The entire spectrum of severe accident phenomena is treated in MELCOR in a unified code framework. This paper describes the in-vessel modeling in

MELCOR in the areas of thermal-hydraulics, core heat transfer and melt progression, and radionuclide release and transport. Results from a preliminary MELCOR calculation for a short term, high pressure, station blackout scenario at LaSalle are presented to illustrate the effects of core relocation and natural circulation on the course of the accident.

29122 (NUREG/CP—0091-Vol.2, pp 287-313) **Evaluation and improvement in nondestructive examination (NDE) reliability for inservice inspection of light water reactors.** Doctor, S.R.; Deffenbaugh, J.D.; Good, M.S.; Green, E.R.; Heasler, P.G.; Simonen, F.A.; Spanner, J.C.; Taylor, T.T. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1988. NTIS, PC A20/MF A01 - GPO. Order Number TI88006107/JAW. (CONF-8710111—Vol.2). Contract AC06-76RL01830.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

The Evaluation and Improvement of NDE Reliability for Inservice Inspection of Light Water Reactor (NDE Reliability) program at the Pacific Northwest Laboratory was established by the NRC to determine the reliability of current inservice inspection (ISI) techniques and to develop recommendations that will ensure a suitably high inspection reliability. The objectives of this program include determining the reliability of ISI performed on the primary systems of commercial light-water reactors (LWRs); using probabilistic fracture mechanics analysis to determine the impact of NDE unreliability on system safety; and evaluating reliability improvements that can be achieved with improved and advanced technology. A final objective is to formulate recommended revisions to ASME Code and Regulatory requirements, based on material properties, service conditions, and NDE uncertainties. The program scope is limited to ISI of the primary systems including the piping, vessel, and other inspected components. This is a progress report covering the programmatic work from October 1986 through September 1987.

29123 (NUREG/CP—0091-Vol.2, pp 315-332) **Development and validation of a real-time SAFT-UT system for in-service inspection of LWRs.** Doctor, S.R.; Hall, T.E.; Reid, L.D.; Mart, G.A. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1988. NTIS, PC A20/MF A01 - GPO. Order Number TI88006107/JAW. (CONF-8710111—Vol.2). Contract AC06-76RL01830.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

The Pacific Northwest Laboratory is working to design, fabricate, and evaluate a real-time flaw detection and characterization system based on the synthetic aperture focusing technique for ultrasonic testing (SAFT-UT). The system is designed to perform inservice inspection of light-water reactor components. Included objectives of this program for the Nuclear Regulatory Commission are to develop procedures for system calibration and field operation, to validate the system through laboratory and field inspections, and to generate an engineering data base to support ASME Code acceptance of the technology. This progress report covers the programmatic work from October 1986 through September 1987.

29124 (NUREG/CP—0091-Vol.2, pp 333-342) **On-line acoustic emission monitoring for crack growth in LWRs.** Hutton, P.H.; Friesel, M.A.; Kurtz, R.J. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1988. NTIS, PC A20/MF A01 - GPO. Order Number TI88006107/JAW. (CONF-8710111—Vol.2).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

Program activities to develop Acoustic Emission/Flaw Relationships for Inservice Monitoring of LWRs are discussed in this paper. The program is supported by the NRC Research Office with supplemental funding provided by the TVA. Accomplishments for FY87 and plans, for FY88 are presented under the topics of technology development, validation on a reactor, standard and code acceptance, and dissemination of the technology. Subjects include detection of very slow crack growth, pattern recognition, on-reactor AE system performance testing, ASTM Standard, ASME Code item, and technology dissemination through application. The current program work continues to emphasize technology transfer.

29125 (NUREG/CP—0091-Vol.2, pp 343-361) **Evaluation of advanced and current leak detection systems.** Kupperman, D.S. (Argonne National Lab., IL (USA)). Feb 1988. NTIS, PC A20/MF A01 - GPO. Order Number TI88006107/JAW. (CONF-8710111—Vol.2). Contract W-31-109-ENG-38.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

Differences between PWRs and BWRs with regard to leak detection have now been analyzed. With regard to detection methods, the greatest differences between reactor types are as follows: (a) the sump pump is reported as the detection method more frequently in BWRs than in PWRs (64% vs. 35%); (b) the radiation monitor is reported as the detection method (excluding false alarms) more frequently in PWRs. Current efforts at Argonne National Laboratory (ANL) to evaluate advanced acoustic leak detection methods are directed toward the generation and analysis of acoustic data from large (0.5 to 10 gal/min) leaks and modification of the software of the GARD/ANL advanced acoustic leak detection system. In order to reach the goal of 10 gal/min leaks, the Steam Generator Test Facility at ANL has been modified to carry out the leak testing. Tests were carried out with water at 525°F and 1100 psi leaking through a fatigue crack in a 4-in. schedule 80 pipe. The crack opening can be varied and was set to generate 0.6- to 8.5-gal/min leaks. Acoustic signals were analyzed with respect to rms values, frequency content, and cross-correlation functions. The GARD/ANL advanced acoustic leak detection system software has been modified to permit intelligent continuous acoustic leak monitoring of reactor components. In the monitor mode the computer continually evaluates the rms signal output of acoustic leak detection sensors placed on the primary circuit. If a leak is suspected, acoustic signals are captured and analyzed to determine the source of the leak, the location and estimated leak rate.

29126 (NUREG/CP—0091-Vol.2, pp 363-379) **Improved eddy-current inspection for steam generator tubing.** Dodd, C.V.; Deeds, W.E. (Oak Ridge National Lab., TN (USA)). Feb 1988. NTIS, PC A20/MF A01 - GPO. Order Number TI88006107/JAW. (CONF-8710111—Vol.2). Contract AC05-84OR21400.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

The Oak Ridge National Laboratory is working on a number of steam generator and eddy-current problems, and one of the most promising developments is the use of reflection type probes. This probe consists of a driver coil encircling and coaxial with two pick-up coils, which are connected in opposition. The reflection probe is mounted perpendicular to the tube axis with one pick-up coil pressed against the surface like a pancake coil. Studies were performed to determine the best probe dimensions to maximize the ratio of defect signals to the undesired property variations at different frequencies. Comparisons between reflection probes and the traditional circumferential or bobbin probes show that the former are more sensitive to defects and less sensitive to variation of properties outside the tube, such as tube supports, magnetite, and copper. The probe can be used in either multiple frequency or pulsed instruments in a manner similar to the bobbin probes. Since the undesired property variations have a smaller effect on the signal, they are easier to eliminate using multiple frequency or pulsed techniques. This has been demonstrated by test runs on standard steam generator tubes with different types of defects and different property variations. The reflection probe has given measurements of actual intergranular stressed-controlled cracking cracks that compare well to the metallographic results. This type of probe has very good resolution and gives fine and accurate scans of the tubing, but is more expensive, complex, and slower.

29127 (NUREG/CP—0091-Vol.2, pp 429-457) **Surry steam generator program - final results - evaluation of NDE performance and technical basis for improved ISI and plugging criteria.** Kurtz, R.J.; Bickford, R.L.; Bowen, W.M.; Bradley, E.R.; Doctor, P.G.; Ferris, R.H.; Fetrow, L.K.; Simonen, F.A. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1988. NTIS, PC A20/MF A01 - GPO. Order Number TI88006107/JAW. (CONF-8710111—Vol.2).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

The principal objectives of the program were to assess the effectiveness of Regulatory Guides 1.83 and 1.121 to (1) define the frequency, extent and procedure for conducting nondestructive in-service inspections (ISIs) of steam generator tubing, and (2) determine tube plugging limits of service-degraded tubing under normal operating and accident loading conditions. To reach these objectives the program utilized a retired-from-service steam generator from the Surry 2 Nuclear Station. Nondestructive (NDE) and destructive examinations of the generator provided information on the accuracy and precision of eddy current (EC) and development inspection methods to detect, characterize and size flaws in steam generator tubing. In addition, burst testing of laboratory and service defected tubing was performed to validate models of remaining tube integrity developed previously. Results are discussed.

29128 **Simulation of the Chernobyl accident.** Fletcher, C.D.; Chambers, R.; Bolander, M.A.; Dallman, R.J. (Idaho National Engineering Lab., Idaho Falls (USA)). *Nuclear Engineering and Design;* **105**: No. 2, 157-172(Jan 1988).

An analysis of the April 26, 1986 accident at the Chernobyl-4 nuclear power plant is presented. The peak calculated core power during the accident was 550000 MW/sub t/. The analysis provides insights that further understanding of the plant behavior during the accident. The plant was modeled with the RELAP5MOD2 computer code using information available in the open literature. RELAP5MOD2 is an advanced computer code designed for best-estimate thermal-hydraulic analysis of transients in light water reactors. The Chernobyl-4 model included the reactor kinetics effects of fuel temperature, graphite temperature, core average void fraction, and automatic regulator control rod position. Preliminary calculations indicated the effects of recirculation pump coast down during performance of a test at the plant were not sufficient to initiate a reactor kinetics-driven power excursion. Another mechanism, or 'trigger' is required. The accident simulation assumed the trigger was recirculation pump performance degradation caused by the onset of pump cavitation. Fuel disintegration caused by the power excursion probably led to rupture of pressure tubes. To further characterize the response of the Chernobyl-4 plant during severe accidents, simulations of an extended station blackout sequence with failure of all feedwater are also presented. For those simulations, RELAP5MOD2 and SCDAPMOD1 (an advanced best-estimate computer code for the prediction of reactor core behavior during a severe accident) were used. The simulations indicated that fuel rod melting was delayed significantly because the graphite acted as a heat sink.

29129 **Medical and radiobiological basis of radiation accident management.** Lushbaugh, C.C.; Fry, S.A.; Ricks, R.C. (Oak Ridge Associated Universities, Inc., TN (USA)). *British Journal of Radiology;* **60**: No. 720, 1159-1163(Dec 1987). (CONF-8704282—). Contract AC05-76OR00033.

From Nuclear reactor accidents: preparedness and medical consequences; Southampton, UK (2 Apr 1987).

A brief historical review of world wide acute radiation deaths and their documentation as a result of major radiation accidents from 1944 - January 1987 is discussed as a basis for dose estimation and medical practice after the Chernobyl accident, and the contribution that Chernobyl will make to future medical management of radiation emergencies is discussed. (U.K.).

29130 **Severe core damage and associated in-vessel fission product release.** Alison, C.; Hagrman, D.; Carlson, E.; Broughton, J.; Rest, J.; Lorenz, R. (Idaho National Engineering Lab., Idaho Falls (USA);Argonne National Lab., IL (USA);Oak Ridge National Lab., TN (USA)). *Progress in Nuclear Energy;* **20**: No. 2, 89-132(1987).

A review is presented of the current state of knowledge about the progression of severe core damage with emphasis on the release of fission products from the fuel. The areas where data are limited or show wide variations are determined. Also, models which need further development are identified. The results of studies for hypothetical accidents are compared and the TMI-2 accident scenario and analytical results are briefly reviewed. The important aspects of data acquired experimentally are summarized.

29131 **Excellence through radiation protection practices.** Lee, D.A.; Armitage, G.; Popple, R.T.; Carrigan, J.T. *Transactions of the American Nuclear Society;* **54**: 183-185(1987). (CONF-870837—).

From 13. American Nuclear Society international meeting on nuclear power plant operation; Chicago, IL, USA (30 Aug 1987).

The nuclear generation program at Ontario Hydro was initiated in the early 1960s. Over the last two decades the program has expanded to a planned capacity of ~ 14,000 MW(electric) by 1992. Each of the nuclear stations consists of four identical reactor units and they range in size from 520 to 880 MW(electric). The overall objectives of Ontario Hydro's radiation protection program are stated as follows: (1) to prevent detrimental nonstochastic health effects to employees and the public; (2) to limit detrimental stochastic health effects occurring in employees or the public to levels as low as reasonably achievable (ALARA), social and economic factors being taken into account; and (3) to provide a level of health and safety that is as good as, or better than, comparable safe industries. Although many elements of the radiation protection program are similar to those adopted by other electrical utilities around the world, there are some unique features that have played an important part in the improvements achieved. These include: management commitment, design responsibility, radiation protection training, operations control, and work planning. The issues that need to be addressed in striving for overall excellence in radiological safety over the next decade are summarized.

29132 **Duty health physicist program at Byron Nuclear Power Station - a cost-effective way to manage routine plant health physics activities.** Goldsmith, D.G.; Carey, T.R. *Transactions of the American Nuclear Society;* **54**: 185(1987). (CONF-870837—).

From 13. American Nuclear Society international meeting on nuclear power plant operation; Chicago, IL, USA (30 Aug 1987).

The Duty Health Physicist Program at Byron Station was established to deal with routine health physics tasks and provide an interface between frontline and upper radiation-chemistry management. The program consists of a weekly rotation of selected members of the health physics staff into the duty health physicist position to handle the assigned duty tasks. The tasks include, but are not limited to, daily isotopic and air sample review, effluent release package review, maximum permissible concentration calculations, dose approvals, as-low-as-reasonably-achievable action review of pending jobs, and general availability to answer questions and address problems in health-physics-related areas of plant operation. The daily attendance of the duty health physicist at the radiation-chemistry and station plan-of-the-day meetings has increased the overall presence and visibility of the health physics program to upper station management and other station departments. Since its inception in July of 1985, the Duty Health Physics Program has been a major contributor to the observed 50% reduction in reportable personnel errors in the radiation-chemistry department.

29133 **Using employee involvement in upgrading radiological work practices.** Beckman, W. *Transactions of the American Nuclear Society;* **54**: 185-186(1987). (CONF-870837—).

From 13. American Nuclear Society international meeting on nuclear power plant operation; Chicago, IL, USA (30 Aug 1987).

Following the shutdown of the Midland Plant in 1984, Consumers Power Company found itself with a need to reorganize its nuclear operations department (NOD). The NOD support staff no longer needed to be located in the company headquarters and was integrated into the Palisades Plant organization. In an attempt to understand the problems confronting the plant, the new organiza-

tion set up a group of meetings for each department to identify barriers to becoming a high-performance organization. In addition to the barrier meetings, the Institute of Nuclear Power Operations (INPO) and the US Nuclear Regulatory Commission (NRC) assisted in identifying additional problem areas during their normal inspection. Support was also provided by INPO during an assist visit in early 1985. That assist visit provided new ideas as well as impetus and credibility to many of the planned corrective actions determined from the barrier meetings. Corrective actions were collected, placed on a punch list, and worked off over an 18-month period. The results of these actions have been encouraging. The number and significance of NRC violations and NPO findings have been reduced. Radwaste generation and auxiliary building contamination have decreased significantly. Costs have been reduced due to reductions in staff, contract services, and radioactive waste. The most significant improvements have been in worker morale and increased cooperation from other plant departments.

29134 **Considerations in the development and implementation of a maintenance robot for nuclear power facilities.** Rohrabacher, A.; Carlton, R.; Gelhaus, F. *Transactions of the American Nuclear Society;* **54**: 186(1987). (CONF-870837—).

From 13. American Nuclear Society international meeting on nuclear power plant operation; Chicago, IL, USA (30 Aug 1987).

The Nuclear Power Division of the Electric Power Research Institute (EPRI) began its automated nuclear plant maintenance research (research project 2232) in 1982 with surveys of domestic and Japanese ongoing and potential uses of robotic systems in nuclear power facilities. After studying these potential research areas, EPRI initiated a three-pronged effort. All surveys concluded that a mobile system for general environmental, visual, and auto surveillance would be beneficial, and EPRI contracted for the development and evaluation of the Surveyor robot. Work also began to catalog existing systems and to quantify the methodology that a utility could use to optimally complete the plant-mission, robot-system selection process. The conceptualizing phase of the effort defined the necessary physical attributes for the machine to perform a variety of maintenance tasks. Characteristics such as mobility, strength, conditions of service, materials of construction, tool functional requirements, facility interfaces, and operator interface were defined to the extent practical. Substantial versatility is required for the variability of the targeted maintenance tasks and for the variability of facility layouts and designs found throughout the nuclear industry. A key contribution to this development effort comes from the project's Utility Advisors Group. The contract's host utility provides membership to lead this group, and that company will train in the use of the machine for 6 months prior to utilizing it in their power plant for 2 yr.

29135 **FFTF integrated leak rate computer system.** Hubbard, J.A. *Transactions of the American Nuclear Society;* **54**: 193(1987). (CONF-870837—).

From 13. American Nuclear Society international meeting on nuclear power plant operation; Chicago, IL, USA (30 Aug 1987).

The Fast Flux Test Facility (FFTF) is a liquid-metal-cooled test reactor located on the Hanford site. The FFTF is the only reactor of this type designed and operated to meet the licensing requirements of the Nuclear Regulatory Commission. Unique characteristics of the FFTF that present special challenges related to leak rate testing include thin wall containment vessel construction, cover gas systems that penetrate containment, and a low-preasure design basis accident. The successful completion of the third FFTF integrated leak rate test 5 days ahead of schedule and 10% under budget was a major achievement for the Westinghouse Hanford Company. The success of this operational safety test was due in large part to a special network (LAN) of three IBM PC/XT computers, which monitored the sensor data, calculated the containment vessel leak rate, and displayed test results. The equipment configuration allowed continuous monitoring of the progress of the test independent of the data acquisition and analysis functions, and it also provided overall improved system reliability by permitting immediate switching to backup computers in the event of equipment failure.

29136 **Zircaloy-steam interactions during nuclear-fuel-rod heatup and melting.** Allison, C.M. Moscow, ID; Univ. of Idaho (1987). 112p. University Microfilms Order No. 87-09,238.

Thesis (Ph. D.).

Research by the nuclear industry and regulating agencies has shown that the oxidation and melting of the Zircaloy cladding of nuclear fuel rods has a dominant influence upon the behavior of a reactor core during a severe accident like TMI-2. The work presented in this dissertation addresses three important aspects of that research. First, the influence of Zircaloy oxidation and melting upon overall nuclear fuel rod behavior is characterized through a critical review of experimental results and comparison of results from oxidation experiments with fuel-rod heating and melting experiments. Second, the fundamental mechanisms controlling the oxidation and melting of Zircaloy are defined through a critical review and discussion of oxidation experiments and supporting analytical work. Third, a finite elements model that treats the coupled heat conduction and oxygen diffusion within Zircaloy during heatup and melting, is presented and discussed. This model offers a significant extension of previous analytic capabilities with the incorporation of the Zr-ZrO_2 binary phase diagram, algorithms to track the movement of a varying number of solid-solid or solid-liquid interfaces, and temperature - and concentration-dependent material properties.

25 Batteries

REFER ALSO TO CITATION(S) 29324

29 ENERGY PLANNING AND POLICY

2901 Energy Analysis And Modeling

REFER ALSO TO CITATION(S) 29150, 29157

2902 Economics And Sociology

REFER ALSO TO CITATION(S) 29148

29137 (EPRI-AP—5247, pp 3.357-3.383) **Residual fuel oil quality market trends and utility management options.** Mueller, H. Jun 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920473/JAW. (CONF-8610288—).

From 2. fuel oil utilization workshop; Philadelphia, PA, USA (7 Oct 1986).

The purpose of this paper is to report on some of the key results of a recently completed research effort that was jointly funded by EPRI and a group of East coast utilities. The study, Residual Fuel Oil Quality: Market Trends and Management Options, had several objectives: identify and quantify the changes in resid oil quality, and the factors that have brought about that change; use that understanding to develop projections of where resid quality may be heading, to permit utilities and EPRI to address tomorrow's problems, not yesterday's; develop comparisons of the costs of alternative management options, especially market options; and develop guidance for residual oil quality management at the fuel procurement stage. The most important general conclusion of this effort is simply this: by expending the resources and management effort needed to implement several key procurement and resid oil management actions, utilities can increase their flexibility to accept a wider range of residual fuel oil quality. The ability to accept a wider quality range provides important economic benefits, and can often permit the utility to take advantage of very favorable resid market opportunities.

29138 **Implementing energy price reform in developing countries.** Hill, L.J. (Oak Ridge National Lab., TN (USA)). *Natural Resources Forum;* **12**: No. 1, 57-67(Feb 1988).

Serious commercial and financial problems have arisen from the tendency of developing country governments to shield their do-

mestic economies from the energy price rises following upon the precipitious rise in petroleum prices in the 1970's. A general programme is outlined for energy prices in the 1970's. A general programme is outlined for energy price reform taking account of the importance of low energy prices for development and government sensitivity to possible sociopolitical instability. Changes in energy prices to cost-based levels should be achieved gradually and adverse economic and sociopolitical effects mitigated by measures designed to improve the efficiency of energy supply and use.

2903 Environment, Health, And Safety

REFER ALSO TO CITATION(S) 28891, 28893, 28898, 28900, 29149, 29155, 29416, 29418, 29426, 29443, 29444, 29445, 29446, 29447, 29448, 29486

29139 (AD-A—187830/5/XAB) Strategic plan for the Air Force Logistics Command in response to the proposed federal regulation of used oil as a hazardous waste. Master's thesis. Scott, D.A. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Systems and Logistics). Sep 1987. 151p. (AFIT/GLM/LS—87S-65). NTIS, PC A08/MF A01.

The purpose of this study was to provide decision makers with the information necessary to determine the optimal alternative to the current waste-disposal strategy in view of the proposed EPA intent to regulate used oil as hazardous. Through the use of statistical analysis, forecasting techniques, and economic ratio calculations, re-refining was identified as the optimal solution for the Air Force Logistics Command (AFLC). Analysis of the results indicated two major problem areas in the current waste-oil management program: 1) lack of funding for the AFLC PACER REDUCE data base project, and 2) lack of forecasting capability in the Defense Reutilization and Marketing Service (DRMS) data base.

2904 Natural Resources

REFER ALSO TO CITATION(S) 28876, 28877, 29148, 29569

29140 (PB—88-160643/XAB) Effect of conservation programs on the quality of urban lawns. Winje, A.S.; Flack, J.E. (Colorado State Univ., Fort Collins (USA). Water Resources Research Inst.). Sep 1986. 93p. (COMPLETION—142). NTIS, PC A05/MF A01.

Growing populations and a limited water supply have made water conservation a necessary part of municipal supply programs for most Front Range Colorado cities. The study was conducted to determine if intensity of conservation programs has an effect on the quality of urban lawns. Lawn quality was measured on a random sample of 209 lawns in seven northern Colorado cities. The statistical tests and other observations contain trends suggesting that higher conservation intensity and water price result in lower lawn quality. However, acceptable lawn quality can be expected even with a moderate level of conservation intensity and price.

29141 (PB—88-164306/XAB) Desertification control and renewable-resource management in the Sahelian and Sudanian zones of west africa. Technical paper. Falloux, F.; Mukendi, A. (International Bank for Reconstruction and Development, Washington, DC (USA)). 1987. 132p. (WORLD-BANK-TP—70). NTIS MF A01.

Library of Congress catalog card No. 87-21534; Microfiche copies only. Paper copy available from World Bank, 1818 H St., NW, Washington, DC 20433.

This volume is a compendium of papers presented at the 'Workshop on Desertification Control and Renewable Resource Management' held in Oslo, Norway in June 1986, and sponsored by the Norwegian Ministry of Development Cooperation, the Canadian International Development Agency and the World Bank. The main objective of the workshop was to develop workable guidelines for addressing the problem of resource depletion in the Sahelian and Sudanian zones of West Africa. Major policy areas covered include land tenure, water management, household energy use, production systems, and migration.

29142 (PNL—6485) Ecological baseline study of the Yakima Firing Center proposed land acquisition:. Rogers, L.E.; Beedlow, P.A.; Eberhardt, L.E.; Dauble, D.D.; Fitzner, R.E. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1988. Contract AC06-76RL01830. 44p.

A baseline census was conducted from October 1987 to Janurary 1988 on the property identified for possible expansion of the Yakima Firing Center. These studies provide general descriptions of the major plant communities presentand animal inhabitants during the late fall and winter study period. A vegetation map derived from a combination of onsite surveillance and remotely sensed imagery is also provided as part of this report. Through January 1988, 13 wildlife species of special interest to state and federal agencies, in addition to ducks and geese, were observed on the proposed expansion area. Then raptorial bird species were observed in the area, including bald eagles, golden eagles, and prairie falcons. Upland game bird species, such as sage grouse, California quail, chuckars, and gray (Hungarian) partridge were present. Loggerhead shrikes, a species of special interest, were also observed on the site. Estimates of waterfowl abundance are included for the Priest Rapids Pool of the Columbia River, which includes the proposed river crossing sites. The number of waterfowl on the proposed crossing areas were comparatively low during the winter of 1986 to 1987 and high in 1987 to 1988. Bald eagles ad common loons were observed on the crossing areas. Six small mammal species were captured during this study period;one, the sagebrush vole, is a species of special interest. Two large animal species, mule deer and elk, were noted on the site. Beaver were the only furbearig animals noted to date. Rainbow trout were the only fish species collected within the proposed northern expansion area. The distribution of fall chinook salmon spawning areas was documented within the proposed river crossing areas. 3 refs., 7 figs., 3 tabs.

2905 Research, Development, Demonstration, And Commercialization

REFER ALSO TO CITATION(S) 28872, 29569

29143 (BNL—40819) Brookhaven National Laboratory technology transfer report, fiscal year 1987. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 62p.

The Brookhaven Office of Research and Technology Applications (ORTA) inaugurated two major initiatives. The effort by our ORTA in collaboration with the National Synchrotron Light Source (NSLS) has succeeded in alerting American industry to the potential of using a synchrotron x-ray source for high resolution lithography. We are undertaking a preconstruction study for the construction of a prototype commercial synchrotron and development of an advanced commercial cryogenic synchrotron (XLS). ORTA sponsored a technology transfer workshop where industry expressed its views on how to transfer accelerator technology during the construction of the prototype commercial machine. The Northeast Regional utility Initiative brought 14 utilities to a workshop at the Laboratory in November. One recommendation of this workshop was to create a Center at the Laboratory for research support on issues of interest to utilities in the region where BNL has unique capability. The ORTA has initiated discussions with the New York State Science and Technology Commission, Cornell University's world renowned Nannofabrication Center and the computer aided design capabilities at SUNY at Stony Brook to create, centered around the NSLS and the XLS, the leading edge semiconductor process technology development center when the XLS becomes operational in two and a half years. 1 fig.

29144 (DOE/EIA—0249(87)) Directory of energy data collection forms:. (USDOE Energy Information Administration, Washington, DC. Office of Statistical Standards). Oct 1987. 63p.

This is an authoritative listing of selected public use forms currently used as basic energy information gathering tools by the Department of Energy (DOE). This directory provides an overview of DOE's energy information collection programs for decisionmakers in government and industry. All DOE forms designed

to collect energy information and used by the EIA that had Office of Management and Budget (OMB) approval on October 1, 1987, are in this directory. For each form listed in this directory, an abstract is included that describes the form's uses, its respondents, and the data collected. Also shown are certain frequently requested items of information. These items include the general energy source(s) and function(s) covered by the form;the general categories of respondents;the frequency of collection;the public laws and, if applicable, regulations associated with the collection;the requirement for reporting;the name and phone number (Washington area code 202 unless noted otherwise) of the data collection manager;and the publications resulting from the data collection. For the reader's convenience in finding specific types of collections, several indices have been provided in this directory. A listing of the forms grouped by energy source and function begins on page 23. Beginning on page 33 are the publications derived from the collections, and on page 47, the forms linked to general respondent categories. Former form number designations appear on page 55. Titles of legal citations referred to in this directory can be found on page 65.

29145 (DOE/S—0061) R and D initiatives for energy competitiveness. (USDOE Office of Energy Research, Washington, DC. Energy Research Advisory Board). Mar 1988. 145p.

The review convinces us that the US can and should use energy competitively. The report recommends three technology initiatives for priority treatment by DOE: oil and gas exploration and production;clean coal technologies, and alternate transportation fuels and propoulsion systems. Additionally, the report recognizes that many other technologies need to be developed and used to advance the nation's competitive position. Bringing these technologies to market is primarily a private-sector responsibility. The Federal government is not necessarily in a position to determine which technologies are best, or to fund their commercialization. However, in order for the private sector to perform most competitively in the world market, government needs to establish an institutional and policy framework conducive to such performance. To this end, we believe that there are four steps that DOE can undertake now. DOE can work to establish a stable planning environment. DOE can encourage new, non-Federal institutions to develop and commercialize new energy technology. DOE can provide the necessary incentives, and remove the disincentives, to private-sector action. Finally, DOE can encourage environmental policies that enhance energy competitiveness. 46 figs.

29146 (K/QT—178) A quality philosophy for research and development. Kidd, G.J. Jr. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Feb 1988. Contract AC05-84OT21400. 17p.

The application of traditional quality assurance techniques to research and development (R and D) has not been successful. This report presents some of the features that distinguish R and D from other industrial enterprises and suggests an approach for adapting existing standards to R and D. 4 figs.

29147 (ORAU—88/A-60) Alexander Hollaender Distinguished Postdoctoral Fellowship Program:. (Oak Ridge Associated Universities, Inc., TN (USA)). 1987. Contract AC05-76OR00033. 128p.

Based on the information provided by the laboratories, ORAU developed and distributed program literature. The program brochure includes a brief program description, eligibility and selection criteria, program benefits and obligations, programs and research areas of OHER, participating laboratories, and other application information. The program description booklet gives more detail on these areas and also includes a biography of Dr. Hollaender and the laboratory descriptions submitted by the participating laboratories. Copies of the brochure and booklet are given in Appendix A. Appendix B includes a listing of promotional activities as well as some examples of program advertisements, press releases, and journal or newspaper articles. Program promotion resulted in the submission of 93 applications during the first cycle of program operation. The 93 applicants received their doctoral degrees from 53 universities in 28 states and from eight universities in six foreign countries. All but three applicants held or expected to receive a PhD degree;two had MDs;one had a DVM degree. The applicants, with more than 40 different academic majors, represent the full range of disciplines in the life, biomedical, and environmental sciences. Appendix C gives detailed information about each applicant.

2906 Nuclear Energy

REFER ALSO TO CITATION(S) 28882, 28891, 28892, 28893, 28898, 28900, 28905, 29087, 29149, 29444, 29447, 29448

2910 Conservation

REFER ALSO TO CITATION(S) 29154

2920 Supply, Demand, And Forecasting

REFER ALSO TO CITATION(S) 29145, 29150

29148 (CONF-880170—1) Impacts of energy development and use, 1888-2088. Wilbanks, T.J. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 67p.

From Centennial symposium on earth: changing geographic perspectives; Washington, DC, USA (25 Jan 1988).

This paper will take a look at energy conditions and their significance at (or near) the years 1888, 1988, and 2088;the major changes in the two intervening periods;and what they mean to us. But the job is complicated by the fact that "energy" is a slippery concept. It is supplied to us in many ways from many different sources, from draft animals to microwaves, and in many different ways as mechanical energy, thermal energy, and electrical energy. It is usually defined in terms of measurable physical units, such as barrels, kilowatts, joules, and calories;but we also talk in terms of "mental energy," which is a very real source of an "ability to do work," the classic definition of "energy." In policymaking, energy can be treated as a resource, a commodity, a strategic material, or a right - an entitlement, a necessity for human beings if they are to lead a decent life. "Energy" is in fact many different things, not something clear-cut and homogeneous. 36 refs., 12 figs., 6 tabs.

2930 Policy, Legislation, And Regulation

REFER ALSO TO CITATION(S) 28891, 29145

29149 (DOE/OR/00033—T399) CIRRPC [Committee on Interagency Radiation Research and Policy Coordination] fourteenth quarterly report, October 1-December 31, 1987. Young, A.L. (Committee on Interagency Radiation Research and Policy Coordination, Washington, DC (USA)). 31 Dec 1987. Contract AC05-76OR00033. 25p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006803/JAW.

This report lists topics of discussion, of science panels, on various aspects of radiation. The Price-Anderson Act is also discussed with respect to its relationship to newly licensed facilities and DOE contracts. Legislation concerning radon and high level waste is also presented. A report on ionizing radiation exposure of populations in the USA is included. (CBS)

2940 Fossil Fuels

29150 (DOE/EIA—M027) The National Coal Model Versions 6 and 7:. (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). Mar 1988. 167p.

The purpose of this manual is to provide a functional guide for users of Version 6 and Version 7 of the National Coal Model (NMC) System. With the aid of this document, the user should be able to access the National Coal Mode, select appropriate inpu files, and obtain the desired output reports. The manual is composed of the following information: an overview of the NCM system, a description of the system files, procedures for updating the data base, description and usage of keys and overrides, and procedures for

using the NCM6 and NCM7 Execution Macros. The manual also contains a terminal operator's guide in Appendix A that describes how to access the EIA computer and log-on to SUPERWYLBUR. Sample output reports are included in Appendix B. The names, addresses, and telephone numbers of personnel to call for assistance are given in this chapter. These references are provided in case problems arise that cannot be resolved using this manual.

2960 Electric Power

REFER ALSO TO CITATION(S) 29446

30 DIRECT ENERGY CONVERSION

3001 Mhd Generators

29151 (DOE/PC/79662—T2) **Space Power MHD System:.** (TRW Space and Technology Group, Redondo Beach, CA (USA). Applied Technology Div.). 15 Dec 1987. Contract AC22-87PC79662. 43p. (K—535-87-RH-174).

This technical progress report of the Space Power MHD System Project presents the accomplishments during the period 1 August to 31 October 1987. The scope of work encompasses the definition of an MHD power system conceptual design and development plan (Task 1). Progress included the following: design and operating requirements for the 100 MW - 500 second power system were reviewed and defined;the proposed power system concept was defined and its principal components specified;initial performance calculations were performed and performance optimization was initiated;a review of the design concept led to an initial issue identification;requests for proposals were issued to both the MIT Plasma Fusion Center and the Westinghouse R and D Center (proposals were received and evaluated);and the Final Design Concept effort was initiated.

3003 Thermoelectric Generators

29152 (DOE/ER/75172—5, pp 7-12) **Radioisotope space power generators: design concepts.** Forsman, T.; Simion, G. (Univ. of New Mexico, Albuquerque (USA)). 1987. NTIS, PC A06/MF A01. Order Number DE88005041/JAW. (CONF-8703231—Summs.).

From Western region American Nuclear Society student conference: nuclear technology for the year 2000; Albuquerque, NM, USA (19 Mar 1987).

The use of radioisotope power systems for space applications has been a key part of some of the most ambitious astronautical undertakings of the US. Nuclear power sources have provided the electrical energy for the NASA Pioneer, Viking, and Voyager missions as well as earlier Earth orbital and Apollo missions. Recently developed, radioisotope thermoelectric generators (RTGs) will be used in the future space missions, such as the Galileo Project (Jupiter study) and the International Solar Polar Mission. This paper surveys present design concepts of RTGs and related dynamic isotope power systems (DIPS).

3005 Fuel Cells

29153 **Methanol fuel cell systems for transport applications.** Vanderborgh, E.; Spirio, A.; Huff, J.R. (Los Alamos National Lab., NM (USA)). *Electric Vehicle Developments;* 7: No. 1, 23-24, 34(Jan 1988).

The transportation fuel sector; that now accounts for significant energy usage (more than 25% in the US), will be increasingly supplied from natural gas. Natural gas reserves are large worldwide, and this fuel is now utilized to produce methanol, a liquid fuel easily transported and stored. Methanol is also synthesized from coal, and countries with abundant coal reserves (the US, for example) can move toward coal-derived methanol as a transportation fuel. Thus, during the next decades, methanol can displace quantities of petroleum used within the transportation sector. Methanol is useful in internal combustion engines, either as a neat or blended (methanol-gasoline) fuel. However, methanol can also serve to power fuel cells, either directly with anodic oxidation of methanol, or indirectly, with methanol first converted to hydrogen, and that gas fed to a hydrogen-air fuel cell device that provides electrical power for traction motors.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

29154 (PNL—6501) **An international comparison of government expenditures for energy conservation research and development:.** McDonald, S.C. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1988. Contract AC06-76RL01830. 72p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88007524/JAW.

This study provides a comparison of US and foreign government spending for energy conservation research and development (R and D). The countries included in this analysis are: the United States, United Kingdom, France, Sweden, West Germany, and Japan. The approach of this paper was to compare the research program of each country at a high level of aggregation with the US Department of Energy (DOE) program structure. This paper does not allow for differences in the way each country defines or accounts for research.

3201 Buildings

29155 (DOE/BP—931) **Radon monitoring results from BPA's [Bonneville Power Administration] Residential Weatherization Program: Report No. 7.** (USDOE Bonneville Power Administration, Portland, OR. Div. of Fish and Wildlife). Jan 1988. 23p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88007379/JAW.

This report lists the accumulated results of the Bonneville Power Administration regionwide Residential Weatherization Program radon monitoring received as of January 1, 1988. This data represents only those readings within the service areas of utilities (and the State of Washington, Department of Community Development) who participate in the Residential Weatherization Program. Several areas in the Pacific Northwest are excluded in this evaluation. In addition, the amount of results received is heavily weighted by the number of homes weatherized and monitored through large utility weatherization programs located in Western Oregon and Washington. This report provides a summary of all the data collected for the States of Oregon, Washington, Idaho, and Montana. Specific data is listed by US Geological Survey designated range and township locations. The specific data listed by range and township includes only those townships with a minimum of five radon readings. This has been done to protect the privacy of those residences participating in the program. The radon measurements results contained in this report were conducted by passive alpha-track radon detectors. The Residential Weatherization Program requires that the detectors be placed in residence for a minimum of 3 winter months, up to 1 year in length. Due to the variations in the length of measurements, we added a section to this report which lists the average radon values for given exposure periods.

29156 (DOE/CE—0166-Vol.3) **Envelope System Performance Compliance Calculation Program documentation: Version 1.0:.** (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC. Building Systems Div.). Nov 1986. 49p.

The microcomputer Envelope System Performance Compliance Calculation Program is part of the Proposed Interim Energy Conservation Standards for New Commercial and Multifamily High Rise Residential Buildings. The program may be used for performing the calculations required for the external envelope requirements and the system performance compliance calculations in Section 5.5 of the Standards. The microcomputer program is provided as a convenience in determining external envelope requirements and calculating if a building design is in compliance with those requirements. The program will perform calculations for up to eight exterior wall orientations at a time. This User's Guide contains instructions for using the program, a list of the cities and climate data in-

corporated into the program, and a listing of the Pascal source code for the program.

29157 **(DOE/SF/00098—H2) An estimate of aggregate energy savings due to the ICP [Institutional Conservation Program] program.** (Lawrence Berkeley Lab., CA (USA)). Mar 1988. Contract AC03-76SF00098. 94p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88007507/JAW.

The purpose of the work reported here is to determine the energy savings attributable to the DOE Institutional Conservation Program (ICP). This study was carried out as one part of a broader evaluation of the ICP performed by Lawrence Berkeley Laboratory and Argonne National Laboratory. The goal of the Evaluation Project is "to identify the most successful conservation measures (equipment and activities) available to the institutional buildings sector." Within this broader context, the specific objective of this study is to determine the impact of the ICP grants program in fostering energy efficiency and in saving energy. This study estimates the aggregate energy savings attributable to retrofit activity in the institutional sector directly or indirectly attributable to ICP, and the remaining opportunities for saving energy. The calculation of aggregate energy savings was divided into two parts: the first considers the impact on energy use of energy conservation measures (ECMs) installed with ICP support ("direct savings"). The second considers how ICP may have influenced institutions that have installed ECMs without ICP support. The energy savings in this case are partially attributable to ICP and are referred to as "indirect savings." For all calculations, energy savings are determined separately for the three subsectors of the institutional sector eligible for ICP support: primary and secondary schools, colleges and universities, and hospitals. All results are expressed in resource energy units and constant 1987 dollars.

29158 **(ORNL/Sub—85-27494/1) Calculational model development for fibrous thermal insulation transient test procedures.** Thomas, J.R. Jr. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Dept. of Mechanical Engineering). Feb 1988. Contract AC05-84OR21400. 68p. NTIS, PC A04/MF A01; GPO Dep. Order Number DE88007843/JAW.

A new theoretical model of transient combined radiation and conduction heat transfer in fibrous insulations has been developed and tested by comparison to experimental data obtained with the ORNL flat screen tester. This model predicts results which agree with this data to within {+-}1.2{degree}C for all of the transient test results available. Sensitivities of the model to the pertinent radiative transfer properties of the insulation have been determined, and are presented in this report. The most important findings are: (1) the extinction coefficient of SRM 1451 fiberglass insulation is approximately 650 m/sup {minus/1};and (2) the fiberglass used in the tests almost certainly contained sufficient moisture to significantly affect the test results. 13 refs., 12 figs., 2 tabs.

29159 **(PB—88-169172/XAB) Combined gas-fired vapor compression/absorption cycles. Annual report, October 1986-September 1987.** Radermacher, R.; Howe, L.A. (Maryland Univ., College Park (USA). Dept. of Mechanical Engineering). Oct 1987. 102p. NTIS, PC A06/MF A01.

Combined vapor compression/absorption heat-pump cycles that use the simultaneous input of work and heat have the potential to take maximum advantage of all forms of energy that are available from internal combustion engines. They significantly increase both heat-pump capacity and coefficient of performance. Three of the five cycles investigated show excellent performance and warrant further work. A performance improvement of approximately 34% for cooling and 18% for heating can be accomplished. This requires an increase in heat-exchange area of 0 to 20% compared to conventional ICE-driven systems.

3202 Transportation

29160 **(PB—88-173380/XAB) Costs and benefits of AC propulsion. Technical report.** Berger, K. (Lea (N.D.) and Associates, Inc., Chantilly, VA (USA)). Jul 1987. 96p. NTIS, PC A05/MF A01.

AC-inverter propulsion offers substantial savings in operating and maintenance costs through elimination of moving parts. The fundamental principle of ac propulsion is described and the sources of the improved reliability and costs savings illustrated. An Appendix to the report presents a cost and reliability data base and life-cycle cost analysis for the cam-controlled DC propulsion system of the New York City Transit Authority R44 cars. It was prepared as a standard of comparison for the evaluation of ac inverter propulsion systems developed under the UMTA Subsystem Technology Applications to Rail Systems (STARS) program, and was used for the cost comparisons of the report. Also in the appendix, the life cycle cost of the R44 car propulsion system is evaluated with a simple present-worth technique.

3203 Industry And Agriculture

REFER ALSO TO CITATION(S) 28922

29161 **(DOE/BP/15109—1) Partial irrigation feasibility study and demonstration project: Phase 4 report.** (Northwest Economic Associates, Vancouver, WA (USA)). Sep 1987. Contract AC79-84BP15109. 157p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88007408/JAW.

This report deals with a three year study of the practice of partial irrigation. (Partial irrigation is defined as the deliberate underirrigation of a crop while maintaining or improving farm income.) Objective was to observe and document the use of this strategy on farms in the Columbia Basin. Wheat and corn were studied as candidates for partial irrigation. Potatoes were included only to better understand how irrigation practices in the Columbia Basin are influenced by this crop. The report begins with a review of the underlying theory of partial irrigation. The second section of the report details the procedures followed during the study. The third section, covering the results of the study, is presented in four parts. The first is a summary of the relevant data. The second consists of observations on the practice of partial irrigation. The results observed for wheat over the three years of the study are interpreted in terms of the theory outlined in the first section. The third part of the results section deals with case studies of the economic merits of the partial irrigation practices that were observed. 26 figs., 23 tabs.

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

3301 Internal Combustion Engines

29162 **(DOE/MC/23256—2565) Performance and emissions of coal-fueled engines using group combustion theory:.** Annamalai, K.;Caton, J.A.;Roth, J.;Ryan, W.;Schmidt, J. (Texas A and M Univ., College Station (USA). Dept. of Mechanical Engineering). Nov 1987. Contract AC21-86MC23265. 227p.

A literature review describes the development of interactive and group combustion (GC) studies, the bubble combustion (BC) model, the pulverized coal gasification and combustion (PCGC) model for burners, the packet combustion (PACC) model for engines, and various NO/sub x/ models. The group combustion (GC) model for a cloud of coal-water slurry drops in a confined volume is described with correction factors. The heat transfer model is given with results for nodal temperatures of cylinder head utilizing iron componet through an engine cycle. The NO/sub x/ model is also given with incorporation into the PACC model;results are given for NO/sub x/ emissions as a function of crank angle, injection timing, inlet manifold temperature etc. Results from the GC model are currently being incorporated in the PACC model. The correction factor from the nonsteady GC model varies from 0.2 to 0.1. Pressure vs time plot confirms GE bomb reactor data. Ignition starts as a heterogeneous process, leading to pyrolysis and the heterogeneous and homogeneous combustion of volatiles. In the preliminary results of the heat transfer model, the temperature swing of interior node of cylinder head is 20{degree}K for insulated case and 35{degree}K for the iron case. The engine cycle simulation for

coal-fueled, reciprocating, internal combustion engines is expanded to include calculations of NO exhaust emissions. Calculations have been completed for a coal-wate slurry fuel. Engine performance parameters are in good agreement with published values. Computed exhaust NO concentrations for both diesel and coal-water slurry fuels are in fair agreement with preliminary experiment. In general, the exhaust NO concentrations are lower for the coal-water slurry fuel relative to the diesel fuel. The thermal NO production for the coal-water slurry fuel is a strong function of the coalwater mass ratio. The NO from fuel-bound nitrogen could be significant for coal-water slurry fuels. 52 figs., 14 tabs.

29163 **(DOE/NASA/50162—1) Prototype thin-film thermocouple/heat-flux sensor for a ceramic-insulated diesel engine.** Kim, W.S.;Barrows, R.F. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Mar 1988. Contract AI01-86CE50162. 14p. (NASA-TM—100798). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88007320/JAW.

A platinum versus platinum-13 percent rhodium thin-film thermocouple/heat-flux sensor was devised and tested in the harsh, high-temperature environment of a ceramic-insulated, low-heat-rejection diesel engine. The sensor probe assembly was developed to provide experimental validation of heat transfer and thermal analysis methodologies applicable to the insulated diesel engine concept. The thin-film thermocouple configuration was chosen to approximate an uninterrupted chamber surface and provide a one dimension heat-flux path through the probe body. The engine test was conducted by Purdue University for Integral Technologies Inc., under a DOE-funded contract managed by NASA Lewis Research Center. The thin-film sensor performed reliably during 6 to 10 hr of repeated engine runs at indicated mean surface temperatures up to 950 k. However, the sensor suffered partial loss of adhesion in the thin-film thermocouple junction area following maximum cyclic temperature excursions to greater than 1150 k. 11 refs., 10 figs., 2 tabs.

29164 **Comparisons of computed and measured dense spray jets.** Martinelli, L.; Bracco, F.V.; Reitz, R.D. pp 484-512 of AIAA progress in astronautics and aeronautics. Volume 95. Los Angeles, CA; American Institute of Aeronautics and Astronautics, Inc. (1984).

Steady spray jets are considered from single cylindrical orifices under conditions of direct fuel injection in internal combustion engines, but at room temperature. Computations were made with a two-dimensional unsteady model that uses atomization results as nozzle exit boundary conditions, a k-epsilon submodel for gas turbulence, and a stochastic algorithm to compute drop events, including collisions and coalescence. Centerline velocity decay, spray width, average drop velocity distributions and standard deviation and skewness and flatness of the drop velocity distribution are compared at several axial and radial locations with corresponding laser Doppler velocimetry data from sprays at three different conditions. Agreement is very good with mean quantities, but the computed standard deviation of the drop velocity distribution (i.e., the drop velocity fluctuation) is generally smaller than the measured one. These nonvaporizing sprays achieve a structure that is very similar to that of fully developed incompressible jets, but 5-10 times further downstream. After development, the drops have little influence on the gas, but the gas controls the motion of the drops. 22 references, 14 figures, 1 table.

3303 Electric-powered Systems

29165 **(EGG-M—12287) A microcomputer-based control and simulation of an advanced IPM [interior permanent magnet] synchronous machine drive system for electric vehicle propulsion.** Bose, B.K.;Szczesny, P.M. (General Electric Co., Schenectady, NY (USA). Corporate Research and Development Center). 1987. Contract AC07-76ID01570;AC07-85NV10418. 41p. (CONF-8711165—1). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88006735/JAW.

From IECON conference; Cambridge, MA, USA (2 Nov 1987).

Advanced digital control and computer-aided control system design techniques are playing key roles in the complex drive system design and control implementation. The paper describes a high performance microcomputer-based control and digital simulation of an inverter-fed interior permanent magnet (IPM) synchronous machine which uses Neodymium-Iron-Boron magnet. The fully operational four-quadrant drive system includes constant-torque region with zero speed operation and high speed field-weakening constant-power region. The control uses vector or field-oriented technique in constant-torque region with the direct axis aligned to the stator flux, whereas the constant-power region control is based on torque angle orientation of the impressed square-wave voltage. All the key feedback signals for the control are estimated with precision. The drive system is basically designed with an outer torque control loop for electric vehicle appliation, but speed and position control loops can be added for other industrial applications. The distributed microcomputer-based control system is based on Intel-8096 microcontroller and Texas Instruments TMS32010 type digital signal processor. The complete drive system has been simulated using the VAX-based simulation language SIMMON to verify the feasibility of the control laws and to study the performances of the drive system. The simulation results are found to have excellent correlation with the laboratory breadboard tests. 19 refs., 14 figs., 5 tabs.

3307 Emission Control

REFER ALSO TO CITATION(S) 29320

29166 **(PB—88-160940/XAB) Effects of trip distance on evaporative hot soak emissions, exhaust emissions, and fuel-tank pressures and temperatures. Technical report.** Pidgeon, W.M. (Environmental Protection Agency, Ann Arbor, MI (USA)). Jun 1987. 109p. (EPA-AA-TEB—87/2). NTIS, PC A06/MF A01.

The Environmental Protection Agency's current computer model for determining the emissions rates of motor vehicles (MOBILE3) does not consider the effects of trip distance and elevated ambient temperatures on hot soak evaporative emissions and exhaust emissions. Additionally, the emissions of vehicles equipped with port fuel injection were expected to be more sensitive to trip distance and elevated ambient temperatures than carbureted and throttle body injected vehicles, and port injected vehicles are expanding their market share. Because these factors can significantly affect the Nation's air quality, EPA initiated a project to test these hypotheses. On-road tests were performed to determine the effects of summertime climate and trip distance on fuel tank temperatures and pressures. The project also included carbureted and throttle body fuel injected vehicles. Correction factors are recommended for trip distance and elevated ambient temperatures in future EPA computer models of motor vehicle emissions rates.

29167 **(PB—88-169115/XAB) Draft regulatory impact analysis and oxides of nitrogen pollutant-specific study. Control of air pollution from new motor vehicles and new motor-vehicle engines: gaseous-emission regulations for 1987 and later-model-year light-duty vehicles, light-duty trucks, and heavy-duty engines; particulate-emission regulations for 1987 and later-model year-heavy-duty diesel engines.** (Environmental Protection Agency, Ann Arbor, MI (USA). Office of Mobile Sources). 1987. 361p. NTIS, PC A16/MF A01.

This document summarizes the results of analyses conducted in support of proposed nitrogen oxide (NOx) emission standards for 1987 and later-model year light duty trucks and the NOx and particulate standards for 1987 and later-model year heavy-duty engines. (49 FR 40258, October 15, 1984). The analyses include consideration of the costs and benefits of the proposed action as well as a comparison of the proposed action with alternative regulatory approaches. The report also includes the environmental impact analyses for NOx and diesel particulate standards.

29168 **(PB—88-172952/XAB) Draft regulatory impact analysis: control of gasoline volatility and evaporative hydrocarbon emissions from new motor vehicles.** (Environmental Protection Agency, Ann Arbor, MI (USA). Office of Mobile Sources). Jul 1987. 521p. NTIS, PC A22/MF A01.

Contents include: in-use motor vehicle-related hydrocarbon emissions (ozone noncompliance situation, effect of volatility on hc

emission factors, benzene emission from gasoline-fueled vehicles as a function of fuel parameters); environmental impacts (description of model and inputs, nationwide and nonattainment area inventory projections, ozone air-quality analysis, benzene emissions and incidence analysis); vehicle controls (technology, costs, conclusions); technological feasibility and cost of in-use volatility control (refinery control of gasoline volatility, the Bonner and Moore studies, refinery costs of volatility control, effect of rvp control on the butane market); analysis of alternatives: gasoline; analysis of alternatives: alcohol blends (industry economics and blend rvp, emission effects of blend usage, effect of rvp control on alcohol blends, gasohol control options, methanol-blend control options).

3308 Alternative Fuels

REFER ALSO TO CITATION(S) 29168

35 ARMS CONTROL

29169 **(AD-A—187992/3/XAB) Analysis of Air Force Systems Command's industrial-surge preparedness planning. Master's thesis.** Hunigan, K.A. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Systems and Logistics). Sep 1987. 114p. (AFIT/GSM/LSY—87S-10). NTIS, PC A06/MF A01.

As U.S. foreign policy calls for a decrease in Intermediate-range Nuclear Forces in Europe, the U.S. needs to increase its conventional capability in order to maintain vigilant deterrence against the Warsaw Pact forces. The objective of this study was to analyze Air Force Systems Command's industrial-surge preparedness planning and policies and how they are implemented at five major product divisions. This research documents findings and concerns about AFSC's surge preparedness planning and policies, outside influences and relationships, and recommendations for future industrial-base initiatives. Interviews disclosed that industrial surge preparedness planning is a low-priority responsibility. It is not sufficiently funded and rarely addressed at program reviews or milestone decisions. Furthermore, the using commands do not usually offer their surge requirements, but expect AFSC to determine the user's surge requirements for them. A survey indicated that for many programs, surge was not a requirement. However, tactical systems had the greatest share of surge requirements. The survey also indicated that program offices are seldom questioned about surge considerations from their chain of command or their users. Finally, the survey showed that many of the program and project managers have had little to no exposure to surge-preparedness planning through their formal education.

3503 Verification

REFER ALSO TO CITATION(S) 28912

36 MATERIALS

29170 **(DOE/ER/13089—T1) .Continuous damage mechanics:.** (Illinois Univ., Chicago (USA)). 1987. Contract AC02-83ER13089. 4p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88007556/JAW.

During the Phase I of this, DOE sponsored research project, the focus was initially placed on the development of a rational phenomenological continuum damage mechanics (CDM) theory based on the salient trends of its macro-response. The existing CDM models were carefully scrutinized and a radically different model was formulated as a phenomenologically more appropriate alternative rigorously based on the basis of the principles of thermodynamics with internal variables. The proposed analytical model was successfully applied to predict the tensile and splitting modes of rock and concrete fracture, creep ruture of metals, time independent fracturing of embrittled metals and even microfracturing of the long, cortical bones of haversian type. The applications or the proposed phenomenological model demonstrated its simplicity, versatility and accuracy in a variety of problems, for a wide range of materials under different circumstances. 16 refs.

3601 Metals And Alloys

REFER ALSO TO CITATION(S) 28831, 28885, 29005, 29084, 29258, 29259, 29289, 29357, 29358, 29714

29171 **(AD-A—189025/0/XAB) Elevated-temperature crack-growth studies of advanced titanium aluminides. Final report, September 1986-April 1987.** Venkataraman, S. (Systran Corp., Dayton, OH (USA)). Sep 1987. 77p. NTIS, PC A05/MF A01.

Ordered intermetallic titanium aluminide Ti Al alloyed with niobium possesses attractive high-temperature properties and moderate low temperature ductibility. Currently, its application is limited to static components in aircraft gas turbine engines. To extend their use to rotating components of turbine engines, better understanding of life limiting processes such as creep/fatigue crack growth and fracture is required. Phase I of this Air Force Small Business Innovative Research program involved investigation of fatigue crack growth in an alpha two titanium aluminide plus niobium alloy (titanium - 16 wt% aluminum - 10 wt% niobium) as a function of temperature and environment. Computer-automated fatigue-crack-growth tests were conducted in both air and vacuum environments at temperatures ranging from room temperature to 1200 F (649 C). Two heat treatment conditions, namely, beta solution and alpha + beta solution resulted in coarse- and fine-grain materials, respectively, with varying alpha two morphology. Fractographic analyses were conducted for all test specimens.

29172 **(AD-A—189228/0/XAB) Large-momentum pairing in one-dimensional systems. Final report, 1 July 1984-31 December 1985.** Allender, D.W. (Kent State Univ., OH (USA). Liquid Crystal Inst.). 1987. 6p. NTIS, PC A02/MF A01.

The primary objective was to determine the correlation function describing large momentum pairing. A comparison of this correlation function with other correlations (such as singlet pairing, triplet pairing, charge density wave, and spin density wave) is now possible. In light of the recent discovery of high temperature superconductivity (T(C) 95K) in rare earth copper oxide materials, it is apparent that a revolution in superconductivity research is beginning.

29173 **(AD-A—189526/7/XAB) Effect of microstructure on the fatigue-crack-growth resistance of nickel-base superalloys. Final technical report, 1 May 1984-30 September 1987.** Antolovich, S.D. (Georgia Inst. of Tech., Atlanta (USA). School of Material Engineering). Dec 1987. 102p. NTIS, PC A06/MF A01.

The objective of this study is to determine the effect of microstructural properties on the fatigue-crack propagation (FCP) response of nickel-base superalloys. This report describes the results of four experimental alloys containing various amounts of aluminum, titanium, and molybdenum. Chemistry, precipitate size, and grain size were varied to produce systematically controlled microstructures. The four alloys were characterized for chemical composition, microstructure, tensile properties, low cycle fatigue (LCF), and FCP resistance. The FCP tests were performed under constant load (increasing K) conditions in air at a stress ratio (R) of 0.1 and 0.8. Closure loads were measured with a clip gage, back-face strain gage, and a laser extensometer.

29174 **(CONF-880547—1) Microstructural characterization and properties of 3Cr-1.5Mo-0.1V thick section electron beam welds.** David, S.A.; King, J.F.; Vitek, J.M. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004330/JAW.

From ASW/EWI power beam conference; San Diego, CA, USA (1 May 1988).

Single pass, full penetration, thick-section (10 cm) electron beam weldments of high integrity were made of 3Cr-1.5Ml-0.1V steel using a 100 kW Sciaky electron beam welder. The weldment was characterized using microhardness measurements, Charpy V-notch impact, tensile, and guided bend tests. Microstructural characterization was done using both optical and electron microscopy. The mechanical properties results showed the electron beam weld-

ments had properties that matched those of the base metal. A hardness minimum within the heat-affected zone (HAZ) was observed on either side of the fusion zone. Such a minimum is commonly observed in ferritic steel weldments, although this region was very narrow compared to the weldments made by other conventional processes. Microstructural characterization of the weld revealed that the fusion zone and immediately surrounding HAZ contained retained austenite between the bainite laths. Further away from the fusion zone, the HAZ structure consisted of bainite and proeutectoid ferrite, which corresponded to the drop in the microhardness, and resulted in a minimum. Tempered bainite was observed beyond this minimum in the HAZ. 14 figs., 2 tabs.

29175 **(CONF-8706103—8) Phase stability and alloy design of ordered intermetallics.** Liu, C.T. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 15p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88007479/JAW.

From NATO advanced study institute on alloy phase stability; Crete, Greece (14 Jun 1987).

Recent research on phase stability and grain boundary structure in ordered intermetallics is summarized. Ordered intermetallics have many attractive high-temperature properties;however, low ductility and brittle fracture limit their use for structural applications. Embrittlement in intermetallics is mainly caused by low-crystal symmetry and insufficient number of slip systems, poor cleavage strength, and intrinsic and extrinsic grain-boundary weakness. Experimental studies of ordered phase stability and grain-boundary structure have led to substantial improvement in the ductility and fracture toughness of several ordered intermetallics, including $(Co,Fe)_3V$, $(Ni,Fe)_3V$, $(Co,Ni,Fe)_3V$, Fe_3Al, Ni_3Al, Ni_3Ga, and Ni_3Si. At present, the control of ordered structures and grain-boundary properties is mainly based on some empirical andor phenomenological relationship. First-principles calculations have advanced to the stage that they are able to help us to understand the electron structure and phase stability and to design ductile ordered intermetallic alloys for structural use at elevated temperatures. 64 refs., 11 figs., 1 tab.

29176 **(EGG-M—12487) Laboratory scale inert gas atomizer for producing rapidly solidified powders.** Korth, G.E.; Storhok, V.W.; Burch, J.V. (EG and G Idaho, Inc., Idaho Falls (USA)). 1988. Contract AC07-76ID01570. 8p. (CONF-880358—2).

From 2. international conference of rapidly solidified materials; San Diego, CA, USA (7 Mar 1988).

An inert gas atomizer was constructed to produce rapidly solidified metal powders in batches of up to 3 kg. The atomizing tank assembly is 0.5 m in diameter x 1.8 m high. Various nozzle/crucible designs and processing parameters were evaluated for their effect on the powder product. The apparatus was utilizing to produce tin, copper, and stainless steel powders with nozzle pressures no greater than 3 MPa and yielding spherical powders ranging from 200 to less than 1 μm. Various nozzle designs were evaluated and preliminary studies were initiated to investigate the process parameters as they pertain to the final powder product. 10 refs., 9 figs., 1 tab.

29177 **(IC—87/92) Influence of argon ion sputtering and annealling on the surface composition of amorphous alloy $Fe_{40}Ni_{40}Si_4B_{16}$ by X-ray photoelectron spectroscopy.** Mikusik, P.; Solomon, B. (Czechoslovak Academy of Science, Prague (Czechoslovakia). J. Heyrovsky Inst.). (International Centre for Theoretical Physics, Trieste (Italy)). Jun 1987. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702527/JAW.

The glossy side of $Fe_{40}Ni_{40}Si_4B_{16}$ is studied by X-ray photoelectron spectroscopy after five different sample treatments as received, three argon ion sputterings and annealling above the crystallization temperature. Composition differences for the five treatments both in the near surface and subsurface region together with chemical states of the sample constituents are discussed. (author). 9 refs, 3 tabs.

29178 **(IC—87/97) Phase stability of random brasses: pseudopotential theory revisited.** Rahman, S.M.M. (International Centre for Theoretical Physics, Trieste (Italy)). Jun 1987. 86p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702532/JAW.

We review the theoretical development concerning the phase stability of random brasses. The introductory discussion of the subject embraces the rules of metallurgy in general, but we emphasize on the roles of electron-per-atom ratio in the major bulk of our discussion. Starting from the so-called rigid-band model the discussion goes up to the recent higher-order pseudopotential theory. The theoretical refinements within the pseudopotential framework are discussed briefly. The stability criteria of the random phases are analysed both in the static lattice and dynamic lattice approximations. (author). 71 refs, figs and tabs.

29179 **(IC—87/178) Van Hove singularities revisited.** Dzyaloshinskii, I. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1987. 19p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702548/JAW.

Beginning with the work of Hirsch and Scalapino the importance of ln^2-Van Hove singularity in T/sub c/-enhancement in La_2CuO_4-based compounds was realized, which is nicely reviewed by Rice. However, the theoretical treatment carried out before is incomplete. Two things were apparently not paid due attention to: interplay of particle-particle and particle-hole channels and Umklapp processes. In what follows a two-dimensional weak coupling model of $LaCuO_4$ will be solved exactly in the ln^2-approximation. The result in the Hubbard limit (one bare charge) is that the system is unstable at any sign of interaction. Symmetry breaking moreover is pretty peculiar. Of course, there are separate singlet superconducting pairings in the pp-channel (attraction) and SDW (repulsion) and CDW (attraction) in the ph-channel. It is natural that Umklapps produce an SDW + CDW mixture at either sign of the interaction. What is unusual is that both the pp-ph interplay and the Umklapps give rise to a monster-coherent SS + SDW + CDW mixture, again at either sign of the bare charge. In the general model where all 4 charges involved are substantially different, the system might remain metallic. A more realistic approach which takes into account dopping in La-M-Cu-O and interlayer interaction provides at least a qualitative understanding of the experimental picture. 10 refs, 5 figs.

29180 **(IS-T—1251) Effect of hydrogen, deuterium and oxygen on the anelastic properties of refractory alloys.** Brasche, L.H. (Ames Lab., IA (USA)). Nov 1987. Contract W-7405-ENG-82. 107p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88007349/JAW.

The effect of hydrogen, deuterium and oxygen on the anelastic properties of V, Nb and V-Nb alloys were examined. Activation parameters were obtained for the oxygen Snoek peak in V and Nb with various hydrogen concentrations. Hydrogen was found not to affect these oxygen relaxation parameters. Thus no interaction of oxygen with hydrogen occurs in the pure metals. Measurement of the hydrogen Snoek peak and the deuterium Snoek peak in V-Nb alloys also led to determination of activation parameters for these interstitials that are consistent with those found by diffusion measurements in this same alloy series. An isotope effect was observed. In addition, oxygen was found not to affect the relaxation of the hydrogen in the V-Nb alloys, indicating that the oxygen-hydrogen interaction in the alloys is also negligible.

29181 **(LA—11202-T) Strain hardening at large strains in aluminum alloys.** Rollett, A.D. (Lawrence Berkeley Lab., CA (USA)). Mar 1988. Contract W-7405-ENG-36. 367p. NTIS, PC A16/MF A01; 1; GPO Dep. Order Number DE88007415/JAW.

The strain hardening properties of high purity Al, commercial purity Al, Al-Mn, Al-Mg and Al-Cu alloys have been investigated at large strains in the temperature range 77-473K. Torsion of short thin walled cylinders was chosen as the deformation method. Results indicated that te stage of strain hardening known as Stage IV occurs even in pure face centered metals in torsion. Stage IV is the neraly constant hardening rate observed at large strains. The

hardening rate in Stage IC is approximately 2.10/sup -4/ where the hardening rate has been reduced by the shear modulus and Taylor factor in factor in order to put it in terms of critical resolved shear stresses on a single slip system. A plot of hardening rate versus stress characteristically shows a sharp transition from steadily decreasing hardening rate in Stage III to constant Stage IV. Stage IV does not appear at high homologouss temperatures. Alloying generally extends the occurrence of Stage IV to high temperatures than in pure metals. A model has been developed that is based on the accumulation of dislocation debris such as dipoles and prismatic loops. This model is able to account for the characteristics of Stage IV, such as the sharp transition observed on a plot of hardening rate versus stress. 9 tabs, 122 figs.

29182 **(MLM—3481) Fabrication of a flexible conductor by vapor deposition.** Bailey, J.A.; Nesslage, G.V. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 15 Mar 1988. Contract AC04-76DP00053. 20p.

A physical vapor deposition (PVD) process was developed to deposit copper coatings on polyimide films (Kapton). The Kapton is prepared in a 35-mm format and is metallized to provide flexible conductor material for flat cable fabrication. A prototype PVD process capable of yielding 95 ft of metallized Kapton tape with a copper thickness variation of +-5% was developed. Metallized tape was prepared in thicknesses ranging from 0.5 to 4.0 μm. 11 figs.

29183 **(N—88-16697) Creep and fatigue research efforts on advanced materials.** Gayda, J. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Nov 1987. vp. (NASA-CP—10003-SESS-1; E—3798-SESS-1; NAS—1.55:10003-SESS-1). NTIS, PC A06/MF A01.

Two of the more important materials problems encountered in turbine blades of aircraft engines are creep and fatigue. To withstand these high-temperature phenomena modern engines utilize single-crystal, nickel-based superalloys as the material of choice in critical applications. Recent research activities at Lewis on single-crystal blading material as well as future research initiatives on metal matrix composites related to creep and fatigue are discussed. The goal of these research efforts is improving the understanding of microstructure-property relationships and thereby guide material development.

29184 **(NAGRA-NTB—88-02) Corrosion behaviour of unalloyed steel in Portland cement.** Grauer, R. (Paul-Scherrer-Institut, Wuerenlingen (Switzerland)). (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Jan 1988. 33p. (In German). Nagra, CH-5401 Baden, Switzerland.

The production of hydrogen can cause problems in a repository for low and intermediate level waste. Since the production of gas is mainly due to the corrosion of unalloyed steel, it is important to have as reliable data as possible for the corrosion rate in anaerobic cement. A review of the literature shows that the corrosion current densities are in the range of 0.01 to 0.1 μAcm^2 (corresponding to corrosion rates between 0.1 and 1.2 μma). This implies hydrogen production rates between 0.022 and 0.22 $mol(m^2xa)$. Corrosion rates of the abovementioned order of magnitude are technically irrelevant, so that there is little interest in determining them accurately. Furthermore, their determination entails problems of measurement technique. In the present situation it would therefore appear risky to accept the lower value as proven. Experiments are proposed to reduce the present uncertainty. (author) 35 refs., 10 figs.

29185 (NUREG/CP—0091-Vol.2, pp 5-15) **Constraint and strain rate effects in fracture toughness testing.** Merkle, J.G. (Oak Ridge National Lab., TN (USA)). Feb 1988. NTIS, PC A20/MF A01 - GPO. Order Number TI88006107/JAW. (CONF-8710111—Vol.2). Contract AC05-84OR21400.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

The procedures for measuring the plane strain fracture toughness, K, of metals were originally developed for relatively high yield strength materials, the toughnesses of which were not affected by strain rate. The application of these procedures to lower yield strength and higher toughness structural and pressure vessel steels have since revealed a perplexing combination of problems involving the effects of geometry, stable crack growth and strain rate on the measured values of toughness. Only the geometric problems were encountered in the development of the procedures for measuring K. For fracture in the linear elastic range of the load-displacement curve, these problems were overcome by specifying specimen dimensions sufficiently large with respect to the plastic zone size at fracture. However, in the case of structural and pressure vessel steels, it is not always possible to test specimens large enough for fracture to occur prior to general yielding. Therefore, in these cases, the effects of large-scale yielding prior to fracture cannot be avoided, but since they presently have no analytical explanation they are being treated empirically. The empirical treatments of size effects on fracture toughness are of two types, statistical and phenomenological. The statistical treatments are based on the assumed existence of small-scale inhomogeneities that control the initiation of cleavage fracture. The phenomenological approaches are based on the knowledge that yielding precedes the occurrence of cleavage microcracks and that the tensile ductility increases with decrease hydrostatic stress.

29186 (NUREG/CP—0091-Vol.2, pp 17-40) **Summary of HSST wide-plate crack-arrest tests and analyses.** Naus, D.J.; Bass, B.R.; Keeney-Walker, J.; Fields, R.J.; deWit, R.; Low S.R. III. (Oak Ridge National Lab., TN (USA)). Feb 1988. NTIS, PC A20/MF A01 - GPO. Order Number TI88006107/JAW. (CONF-8710111—Vol.2). Contract AC05-84OR21400.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

Eleven wide-plate crack-arrest tests have been completed to date, seven utilizing specimens fabricated from A533B class 1 material (WP-1 series), and four fabricated from a low upper-shelf base material (WP-2 series). With the exception of one test in the WP-1 series and two tests in the WP-2 series which utilized 152-mm-thick specimens, each test utilized a single-edge notched (SEN) plate specimen 1 by 1 by 0.1 m that was subjected to a linear thermal gradient along the plane of crack propagation. Test results exhibit an increase in crack-arrest toughness with temperature, with the rate of increase becoming greater as the temperature increases. When the wide-plate test results are combined with other large-specimen results (Japanese ESSO, thermal-shock experiments and pressurized-thermal-shock experiments) the data show a consistent trend in which the K/sub Ia/ data extends above the limit provided in ASME Section XI.

29187 (NUREG/CP—0091-Vol.2, pp 41-57) **Performance of low-upper-shelf material under pressurized-thermal-shock loading (PTSE-2).** Bryan, R.H.; Bass, B.R.; Bolt, S.E.; Bryson, J.W.; Corwin, W.R.; Nanstad, R.K.; Merkle, J.G.; Robinson, G.C. (Oak Ridge National Lab., TN (USA)). Feb 1988. NTIS, PC A20/MF A01 - GPO. Order Number TI88006107/JAW. (CONF-8710111—Vol.2). Contract AC05-84OR21400.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

The second pressurized-thermal-shock experiment (PTSE-2) of the Heavy-Section Steel Technology Program was conceived to investigate fracture behavior of steel with low ductile-tearing resistance. The experiment was performed in the pressurized-thermal-shock test facility at the Oak Ridge National Laboratory. PTSE-2 was designed primarily to reveal the interaction of ductile and brittle modes of fracture and secondarily to investigate the effects of warm prestressing. A test vessel was prepared by inserting a crack-like flaw of well-defined geometry on the outside surface of the vessel. The flaw was 1 m long by ~ 15 mm deep. The instrumented vessel was placed in the test facility in which it was initially heated to a uniform temperature and was then concurrently cooled on the outside and pressurized on the inside. These actions produced an evolution of temperature, toughness, and stress gradients relative to the prepared flaw that was appropriate to the planned objectives. The experiment was conducted in two separate transients, each one starting with the vessel nearly isothermal. The first transient induced a warm-prestressed state, during which K/sub I/

first exceeded K/sub Ic/. This was followed by repressurization until a cleavage fracture propagated and arrested. The final transient was designed to produce and investigate a cleavage crack propagation followed by unstable tearing. During this transient, the fracture events occurred as had been planned.

29188 (NUREG/CP—0091-Vol.2, pp 59-91) **Evaluation of viscoplastic fracture criteria and analysis methods.** Bass, B.R.; Pugh, C.E.; Keeney-Walker, J.; Dexter, R.J.; O'Donoghue, P.E.; Schwartz, C.W. (Oak Ridge National Lab., TN (USA)). Feb 1988. NTIS, PC A20/MF A01 - GPO. Order Number TI88006107/JAW. (CONF-8710111—Vol.2). Contract AC05-84OR21400.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

The role of nonlinear rate-dependent effects in the interpretation of crack run-arrest events in ductile materials is being investigated by the Heavy-Section Steel Technology (HSST) program through development and applications of viscoplastic-dynamic finite element analysis techniques. This paper describes a portion of these studies wherein various viscoplastic constitutive models and several proposed nonlinear fracture criteria are being installed in general purpose (ADINA) and special purpose (VISCRK) finite element computer programs. The formulations of the Bodner-Partom, the Perzyna, and the Robinson constitutive models installed in the HSST computer programs are summarized. This is followed by a description of three integral functions that are candidate fracture parameters. The capabilities of these nonlinear techniques are compared and evaluated through applications to one of the HSST wide-plate crack-arrest tests. Results are presented from benchmark viscoplastic-dynamic wide-plate analyses performed using the ADINA and VISCRK computer programs. Finally, plans are summarized for additional computational and experimental studies to assess the utility of viscoplastic analysis techniques in constructing a transferable inelastic fracture mechanisms model for ductile steels. 53 references.

29189 (NUREG/CP—0091-Vol.2, pp 93-112) **Viscoplastic-dynamic analysis of small-scale fracture tests to obtain crack arrest toughness values for PTS conditions.** Kanninen, M.F.; Hudak, S.J. Jr.; Dexter, R.J.; Couque, H.; O'Donoghue, P.E.; Polch, E.Z. (Southwest Research Institute, San Antonio, TX (USA)). Feb 1988. NTIS, PC A20/MF A01 - GPO. Order Number TI88006107/JAW. (CONF-8710111—Vol.2).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

Reliable predictions of crack arrest at the high upper shelf toughness conditions involved in postulated pressurized thermal shock (PTS) events require procedures beyond those utilized in conventional fracture mechanics treatments. To develop such a procedure, viscoplastic-dynamic fracture mechanics finite element analyses, viscoplastic material characterization testing, and small-scale crack propagation and arrest experimentation are being combined in this research. The approach couples SwRI's viscoplastic-dynamic fracture mechanics finite element code VISCRK with experiments using duplex 4340A533B steel compact specimens. The experiments are simulated by VISCRK computations employing the Bodner-Partom viscoplastic constitutive relation and the nonlinear fracture mechanics parameter T. The goal is to develop temperature-dependent crack arrest toughness values for A533B steel. While only room temperature K/sub Ia/ values have been obtained so far, these have been found to agree closely with those obtained from wide plate tests.

29190 (NUREG/CP—0091-Vol.2, pp 113-122) **Evaluation of the presence of constraint in crack run/arrest events.** Schwartz, C.W.; Bass, B.R. (Univ. of Maryland, College Park (USA)). Feb 1988. NTIS, PC A20/MF A01 - GPO. Order Number TI88006107/JAW. (CONF-8710111—Vol.2). Contract AC05-84OR21400.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

Crack arrest studies currently being conducted by the Heavy-Section Steel Technology Program are designed to improve their understanding of the conditions contributing to the arrest of a propagating fracture in a pressure vessel. These studies are generating data spanning a wide temperature range for a variety of experimental configurations. Dynamic crack arrest parameters are backfigured from these experiments through generation mode dynamic viscoplastic finite element calculations driven by the measured crack tip history input. A major approximation in these analyses, which is dictated by the practical limitations of current supercomputer hardware, is the assumption of two-dimensional plane stress conditions. Although this approximation is reasonable over most of the problem domain for many test specimen geometries, it deteriorates at locations near the crack tip due to triaxial constraint effects. This paper describes plans for a fine-grained three-dimensional computational study to investigate the importance of these near-tip triaxial constraint effects on crack tip yielding and to develop appropriate algorithms for incorporating these effects into conventional two-dimensional plane stress approximations.

29191 (NUREG/CP—0091-Vol.2, pp 123-138) **Effects of commercial cladding on the fracture behavior of pressure vessel steel plates.** Iskander, S.K.; Alexander, D.J.; Bolt, S.E.; Cook, K.V.; Corwin, W.R.; Oland, B.C.; Nanstad, R.K.; Robinson, G.C. (Oak Ridge National Lab., TN (USA)). Feb 1988. NTIS, PC A20/MF A01 - GPO. Order Number TI88006107/JAW. (CONF-8710111—Vol.2). Contract AC05-84OR21400.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

The objective of this program is to determine the effect, if any, of stainless steel cladding upon the propagation of small surface cracks subjected to stress states similar to those produced by thermal shock conditions. Preliminary results from testing at temperatures 10 and 60°C below NDT have shown that (1) a tough surface layer (cladding and/or HAZ) has arrested running flaws under conditions where unclad plates have ruptured, and (2) the residual load-bearing capacity of clad plates with large subclad flaws significantly exceeded that of an unclad plate.

29192 (NUREG/CP—0091-Vol.2, pp 139-153) **Detection and characterization of flaws in segments of light water reactor pressure vessels.** Cook, K.V.; Cunningham, R.A. Jr.; McClung, R.W. (Oak Ridge National Lab., TN (USA)). Feb 1988. NTIS, PC A20/MF A01 - GPO. Order Number TI88006107/JAW. (CONF-8710111—Vol.2). Contract AC05-84OR21400.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

Studies have been conducted to determine flaw density in segments cut from light water reactor (LWR) pressure vessels as part of the Oak Ridge National Laboratory's Heavy-Section Steel Technology (HSST) Program. Segments from the Hope Creek Unit 2 vessel and the Pilgrim Unit 2 Vessel were purchased from salvage dealers. Hope Creek was a boiling water reactor (BWR) design and Pilgrim was a pressurized water reactor (PWR) design. Neither were ever placed in service. Objectives were to evaluate these LWR segments for flaws with ultrasonic and liquid penetrant techniques. Both objectives were successfully completed. One significant indication was detected in a Hope Creek seam weld by ultrasonic techniques and characterized by further analyses terminating with destructive correlation. This indication [with a through-wall dimension of ~ 6 mm (~ 0.24 in.)] was detected in only 3 m (10 ft) of weldment and offers extremely limited data when compared to the extent of welding even in a single pressure vessel. However, the detection and confirmation of the flaw in the arbitrarily selected sections implies the Marshall report estimates (and others) are nonconservative for such small flaws. No significant indications were detected in the Pilgrim material by ultrasonic techniques. Unfortunately, the Pilgrim segments contained relatively little weldment; thus, the authors limited their ultrasonic examinations to the cladding and sublcadding regions. Fluorescent liquid penetrant inspection of the cladding surfaces for both LWR segments detected no significant indications [i.e., for a total of approximately 6.8 m^2 (72 ft^2) of cladding surface].

29193 (NUREG/CP—0091-Vol.2, pp 155-176) **Fracture resistance of irradiated stainless steel clad vessels.** McCabe, D.E. (Materials Engineering Associates, Inc., Lanham, MD (USA)). Feb 1988. NTIS, PC A20/MF A01 - GPO. Order Number TI88006107/JAW. (CONF-8710111—Vol.2).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

The surface crack embedded in the clad layer of a reactor vessel has been identified as a critical safety assessment condition relative to the pressurized thermal shock accident scenario. This project was initiated to determine the severity of such cracks experimentally, using irradiated material, and to identify the material property and stress conditions in the local region of the crack that are significant to the analysis. Bend bar tests provided the experimental simulation of the subject RPV surface crack. This report covers analysis techniques used and presents the findings indicated by the experimental results for irradiated and unirradiated materials. The irradiated clad specimens are the first of this type aimed at representing actual conditions in the wall of an irradiated pressure vessel.

29194 (NUREG/CP—0091-Vol.2, pp 177-193) **Effects of irradiation on strength and toughness of commercial LWR vessel cladding.** Haggag, F.M.; Corwin, W.R.; Alexander, D.J.; Nanstad, R.K. (Oak Ridge National Lab., TN (USA)). Feb 1988. NTIS, PC A20/MF A01 - GPO. Order Number TI88006107/JAW. (CONF-8710111—Vol.2). Contract AC05-84OR21400.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

The potential for stainless steel cladding to improve the fracture behavior of an operating nuclear reactor pressure vessel, particularly during certain overcooling transients, may depend greatly on the properties of the irradiated cladding. Therefore, weld overlay cladding irradiated at temperatures and to fluences relevant to power reactor operation was examined. The cladding was applied to a pressure vessel steel plate by the three-wire series-arc commercial method. Cladding was applied in three layers to provide adequate thickness for the fabrication of test specimens. The three-wire series-arc procedure, developed by Combustion Engineering, Inc., Chattanooga, Tennessee, produced a highly controlled weld chemistry, microstructure, and fracture properties in all three layers of the weld. Charpy V-notch and tensile specimens were irradiated at 288°C to fluence levels of 2 and 5 x 10^{10} neutrons/cm^2 (> 1 MeV). Postirradiation testing results show that, in the test temperature range from -125 to 288°C, the yield strength increased by 8 to 30%, ductility insignificantly increased, while there was almost no change in ultimate tensile strength. All cladding exhibited ductile-to-brittle transition behavior during Charpy impact testing, due to the dominance of delta-ferrite failures at low temperatures. On the upper shelf, energy was reduced, due to irradiation exposure, 15 and 20%, while the lateral expansion was reduced 43 and 41%, at 2 and 5 x 10^{19} neutrons/cm^2 (> 1 MeV), respectively. In addition, radiation damage resulted in 13 and 28°C shifts of the Charpy impact transition temperature at the 41-J level for the low and high fluences, respectively.

29195 (NUREG/CP—0091-Vol.2, pp 195-219) **Progress in identification of radiation embrittlement mechanisms.** Hawthorne, J.R. (Materials Engineering Associates, Inc., Lanham, MD (USA)). Feb 1988. NTIS, PC A20/MF A01 - GPO. Order Number TI88006107/JAW. (CONF-8710111—Vol.2).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

This report outlines recent advances in the isolation and understanding of mechanisms behind known composition influences on the radiation embrittlement sensitivity of reactor pressure vessel steels at 288°C. The advances are largely the product of joint investigations by Materials Engineering Associates (MEA) and other laboratories in the US and overseas under cooperative and subcontract arrangements. Specific objectives were: confirmation of the suspect Cu mechanism, identification of the process for the Cu:Ni synergism, and isolation of the P mechanism in radiation sensitivity development. The investigations proceeded with MEA-supplied steels and iron alloys from 4-way split laboratory melts; research tools included Scanning Electron Microscopy, Transmission Electron Microscopy, Field Ion Microscopy, Small Angle Neutron Scattering, Positron Annihilation and Auger Electron Spectroscopy. Experimental results show that P and Cu enhance the radiation elevation of yield strength and that the associated mechanisms are a radiation-induced precipitation of P or Cu-rich clusters which impede dislocation motion. With high Cu alloys, a Cu phosphide is formed in preference to P precipitates and the P contribution is greatly reduced. Effects of postirradiation annealing and reirradiation are also reported.

29196 (NUREG/CP—0091-Vol.2, pp 221-245) **Progress on the degraded piping program - Phase II.** Wilkowski, G. (Battelle Columbus Div., OH (USA)). Feb 1988. NTIS, PC A20/MF A01 - GPO. Order Number TI88006107/JAW. (CONF-8710111—Vol.2).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

The overall objective of the Degraded Piping Program is to verify and improve simple estimation schemes to predict the fracture behavior of circumferentially cracked pipe. The program is limited to quasi-static fracture and cracks in straight pipe. There are a variety of materials, flaw geometries, pipe sizes, and loading conditions evaluated. Third year efforts have contributed considerably to the understanding of the application of elastic-plastic fracture mechanics to nuclear piping systems. Rather than listing the significant technical contributions, these contributions are summarized in relation to their application to (1) leak-before-break analyses, (2) in-service flaw assessment criteria, and (3) material characterization and unusual behavior of nuclear piping materials at light water reactor (LWR) temperatures. 36 references.

29197 (NUREG/CP—0091-Vol.2, pp 247-265) **Development of specimen size and test rate effects on the J-integral upper transition behavior of A553B steel.** Joyce, J.A. (Naval Academy, Annapolis, MD (USA)). Feb 1988. NTIS, PC A20/MF A01 - GPO. Order Number TI88006107/JAW. (CONF-8710111—Vol.2).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

During the past three years a test method has been developed for dynamic testing of fracture mechanics specimens which is specifically designed for application to the upper transition temperature range. The method uses drop tower loading rates of 2.5 msec and obtains a J/sub IC/ or a J-R curve using an analytical key curve approach verified by initial and final crack length measurements obtained from the fracture surface. A J-R curve is obtained from each specimen and contains crack growth corrections so that it is directly comparable with static results obtained in accordance with the ASTM E1152 J-R curve test method. The test procedure has been applied to A106 steel, A533B steel and US Navy HY80 and HY100 steels at temperatures from -200F to 150F. Standard 1T three point bend specimens have been used for all materials and additional 2T three point bend specimens were used for the A533B and the HY100 steel. The following conclusions have been drawn from this work: a dramatic shift in the transition temperature was measured in this A533B material due to test rate; a small effect of specimen size was observed for both drop tower and static test rates; the J/sub EL/ component increases with increased test rate; the J/sub PL/ component decreases with increased test rate - through for A533B this increase is small; and the total J integral can increase or decrease on the ductile upper shelf with increased test rate depending on the relative magnitudes of the J/sub EL/ and J/sub PL/ changes.

29198 (NUREG/CP—0091-Vol.2, pp 267-285) **Use of J-integral and modified J-integral as measures of elastic-plastic fracture toughness.** Davis, D.A.; Hays, R.A.; Hackett, E.M.; Joyce, J.A. (David Taylor Research Center, Annapolis, MD (USA)). Feb 1988. NTIS, PC A20/MF A01 - GPO. Order Number TI88006107/JAW. (CONF-8710111—Vol.2).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

J-R Curve tests were conducted on 12T, 1T and 2T compact specimens of materials having J/sub IC/ values ranging from 150 in-lbsq in to over 2600 in-lbsq in. These materials were chosen such that some would exceed the maximum crack length criterion of

ASTM E1152-87 prior to reaching the maximum J criterion (3-Ni steel, 5000 series Al) and some would exceed the maximum J criterion first (A533B, A710). The elastic-plastic fracture behavior of these materials was examined using both the deformation theory J-integral (J/sub D/) and the modified J-integral (J/sub M/). The J-R curve testing was performed to very large values of crack opening displacement (COD) where the crack growth was typically 75% of the original remaining ligament. The results of this work suggest that the J/sub D/-R curves exhibit no specimen size dependence to crack extensions far in excess of the E1152 allowables. The J/sub M/-R curves calculated for the same specimens show a significant amount of specimen size dependence which becomes larger as the material toughness decreases. This work suggests that it is premature to utilize the modified J-integral in assessing the flaw tolerance of structures.

29199 (NUREG/CP—0091-Vol.2, pp 381-405) **BWR pipe crack remedies evaluation.** Shack, W.J.; Kassner, T.F.; Maiya, P.S.; Park, J.Y.; Ruther, W.; Kuzay, T.; Rybicki, E.F.; Stonesifer, R.B. (Argonne National Lab., IL (USA)). Feb 1988. NTIS, PC A20/MF A01 - GPO. Order Number TI88006107/JAW. (CONF-8710111—Vol.2). Contract W-31-109-ENG-38.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

Piping in light-water-reactor power systems has been affected by several types of environmental degradation. This paper presents results from studies of (1) stress corrosion crack growth in fracture mechanics specimens of modified Type 347 SS and Type 304/308L SS weld overlay material, (2) heat-to-heat variations in stress corrosion cracking (SCC) of Types 316NG and 347 SS, (3) SCC of sensitized Type 304 SS in water with cupric ion or organic acid impurities, (4) electrochemical potential (ECP) measurements under gamma irradiation, (5) SCC of ferritic steels, (6) strain-controlled fatigue of Type 316NG SS in air at ambient temperature, and (7) through-wall residual stress measurements and finite-element calculations of residual stresses in weldments treated by a mechanical stress improvement process (MSIP). Fracture-mechanics crack-growth-rate tests on Type 316NG SS have shown that transgranular cracking can occur even in high purity environments, whereas no crack growth was observed in Type 347 SS even in impurity environments. In tests on weld overlay specimens, the cracks branched when they approached the overlay, and then grew parallel to interface. Type 304 SS, cupric ions at concentrations greater than $\sim$ 1 ppm were found to be deleterious, whereas organic acids were not detrimental. Tests on ferritic steels indicate a strong correlation between the sulfur content of the steels and susceptibility to SCC. External gamma radiation fields produced a large positive shift in the ECP of Type 304 SS at low dissolved-oxygen concentrations ($<$ 5 ppb). Fatigue data for Type 316NG SS are consistent with the ASME code mean curve at high strains, but fall below the curve at low strains. Calculations of the residual stresses produced by MSIP are in reasonable agreement with experimental measurements. 37 references.

29200 (NUREG/CP—0091-Vol.2, pp 407-428) **Long-term aging of cast stainless steels: mechanisms and resulting properties.** Chopra, O.K.; Chung, H.M. (Argonne National Lab., IL (USA)). Feb 1988. NTIS, PC A20/MF A01 - GPO. Order Number TI88006107/JAW. (CONF-8710111—Vol.2). Contract W-31-109-ENG-38.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

Mechanical property data are presented from Charpy-impact, tensile, and J-R curve tests for several heats of cast stainless steel aged up to 10,000 h at 450, 400, 350, 320, and 290°C. The results indicate that thermal aging increases the tensile strength and decreases the impact energy, J/sub IC/, and tearing modulus of the steels. Also, the ductile-to-brittle transition curve shifts to higher temperatures. The ferrite content and concentration of carbon in the steel have a strong effect on the overall process of low-temperature embrittlement. The low-carbon CF-3 steels are the most resistant and the molybdenum-containing high-carbon CF-8M steels are the most susceptible to low-temperature embrittlement. Microstructural data indicate that three processes contribute to embrittlement of cast stainless steels, viz., Cr-rich α' and G-phase precipitation in the ferrite, and carbide precipitation on the austeniteferrite phase boundary. The influence of nitrogen content and ferrite distribution on loss of toughness are discussed. The data also indicate that existing correlations do not accurately represent the embrittlement behavior over the temperature range 280-450°C, i.e., extrapolation of high-temperature data to reactor temperatures may not be valid for some compositions of cast stainless steel.

29201 (ORNL/M—272, pp 11-39) **Alloy design of Ni and Ni-Fe aluminides.** Liu, C.T. 1986. NTIS, PC A06/MF A01. Order Number DE88004668/JAW. (CONF-8605318—Vugraphs).

From 2. workshop on nickel aluminides; Oak Ridge, TN, USA (13 May 1986).

A series of slides summarizes results from a research program on nickel and nickel-iron aluminides. In alloys containing $<$ 25% Al, a small addition of boron improves ductility at ambient temperature and enhances the grain-boundary cohesive energy. Hf and Zr additions are effective in hardening and improve creep resistance of nickel aluminides. The mechanism of dynamic embrittlement of aluminide alloys was also studied. It was found that material with brittle fracture at 600-760 C in air has ductile failure at 25 C; that preoxidation does not embrittle the aluminide samples tested in vacuum at 300-900 C; and that the ductility depends strongly on air pressure at elevated temperatures. Chromium additions improve embrittlement behavior in oxidizing environments. Compositions of three nickel aluminide alloys which were developed and some of their properties are given.

29202 (ORNL/M—272, pp 40-43) **Nickel aluminides for structural use.** Liu, C.T.; Sikka, V.K. 1986. NTIS, PC A06/MF A01. Order Number DE88004668/JAW. (CONF-8605318—Vugraphs).

From 2. workshop on nickel aluminides; Oak Ridge, TN, USA (13 May 1986).

The nickel aluminide Ni_3Al is an intermetallic compound which has attractive properties for structural use at elevated temperatures. The aluminide containing 25 at.% Al is resistant to air oxidation. Unlike conventional metallic alloys, the yield stress of Ni_3Al increases substantially with increasing temperature. The aluminide is the most important strengthening constituent of commercial nickel-base superalloys and is responsible for their high-temperature strength and creep resistance. In addition, the alloy density of Ni_3Al is lower than that of superalloys by about 10%. However, the use of polycrystalline nickel aluminide as an engineering material suffers from the severe problem of poor ductility and brittle intergranular fracture. Recently, considerable effort has concentrated on alloy design of ductile nickel aluminides using physical metallurgy principles. Boron additions are effective in improving ductility and suppressing intergranular fracture in Ni_3Al containing 24 at.% Al, but are ineffective in alloys with $\geq$ 25% Al. by carefully controlling aluminum concentration, boron content and thermomechanical treatment, tensile elongations greater than 50%, and virtually 100% transgranular failure were achieved in Ni-24 at.% Al alloy containing about 0.1 wt% (0.5 at.%B). Auger electron spectroscopic studies revealed that boron tends to segregate strongly to grain boundries in hypostoichiometric Ni_3Al but not to free surfaces. This unique segregation behavior should result in an effective increase in cohesive energy of grain boundaries in Ni_3Al with $<$ 25 at.% Al. This paper discusses elevated temperatures ductility, compositions and properties of advanced nickel aluminides, and fabrication of aluminides by powder processing, extrusion of cast billets, isothermal forging, and twin-roller casting of sheet. 21 references.

29203 (ORNL/M—272, pp 45-69) **Welding the aluminides.** Goodwin, G. 1986. NTIS, PC A06/MF A01. Order Number DE88004668/JAW. (CONF-8605318—Vugraphs).

From 2. workshop on nickel aluminides; Oak Ridge, TN, USA (13 May 1986).

Because of their high temperature strength and the intentional alloying additions (boron, zirconium, etc.), the aluminides are inherently sensitive to welding variables. To understand haz (heat affected zone) cracking, sub-size specimens were tested for their hot ductility in the temperature range 600 to 1300 C. Tensile ductility versus temperature and microstructure of the fractured specimens were determined. In addition the Sigmajig weldability test device

was used to study hot-cracking (fusion zone) sensitivity. Data are presented in a series of graphs.

29204 (ORNL/M—272, pp 72-88) **Physical properties of Ni_3Al.** Williams, R.K. 1986. NTIS, PC A06/MF A01. Order Number DE88004668/JAW. (CONF-8605318—Vugraphs).

From 2. workshop on nickel aluminides; Oak Ridge, TN, USA (13 May 1986).

Data are presented on the following physical properties of nickel aluminide alloys with and without iron additions: thermal conductivity, crystal structure, Debye temperature, thermal expansion coefficient, residual resistivity, Curie temperature, and electrical resistivity. The study concludes that the thermal expansion is insensitive to stoichiometry and less than stainless steel; and transport properties vary rapidly with temperature and composition, i.e., resistivity shows offset from Curie temperature at lower temperatures, thermal conductivity behaves like an alloy, phonon part of thermal conductivity is important and can be calculated from Callaway's Formula, and Lorenz number is close to Sommerfeld value.

29205 (ORNL/M—272, pp 97-113) **Nickel aluminides produced for ORNL [Ni_3Al P/M extruded bar].** Fox, C.W. (Homogeneous Metals, Inc., Clayville, NY (USA)). 1986. NTIS, PC A06/MF A01. Order Number DE88004668/JAW. (CONF-8605318—Vugraphs).

From 2. workshop on nickel aluminides; Oak Ridge, TN, USA (13 May 1986).

A series of photographs explain the fabrication of nickel aluminide extruded bars produced for ORNL. A flowsheet is included on the Clayville atomization system for production of the alloy powders. Data are presented on typical particle size distribution and gas analysis of the powder alloys.

29206 **Structurally induced supermodulus effect in superlattices.** Wolf, D.; Lutsko, J.F. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review Letters;* 60: No. 12, 1170-1173(21 Mar 1988). Contract W-31-109-ENG-38.

It is suggested that the "supermodulus effect" observed for composition-modulated superlattices arises from the presence of the structurally disordered solid interfaces and not necessarily from electronic structure effects.

29207 **Phase stability of ternary alloys in the four-sublattice Bragg-Williams approximation.** Chrzan, D.C.; Falicov, L.M. (Department of Physics, University of California, Berkeley, California 94720). *Physical Review [Section] B: Condensed Matter;* 37: No. 8, 3894-3899(15 Mar 1988).

A full Bragg-Williams calculation of a four-sublattice face-centered-cubic ternary alloy is presented. It corresponds to elements which, similarly to Cu, Ag, and Au, form disparate binaries: one pair that strongly segregates, one pair that forms strongly ordered compounds, and a third pair that forms only weakly ordered binaries. The obtained diagrams are internally consistent, have a sensible temperature evolution towards disorder, and present a variety of behaviors which include ordered and disordered homogeneous single phases, and regions of heterogeneous two- and three-phase mixtures. Although not realistic, the calculation gives a good starting point for more sophisticated models which may include short-range correlations and a better thermodynamic treatment.

29208 **Initial growth modes of Ag on Ni(100) and Ni(111) determined by planimetry with adsorbed CO.** Shapiro, A.P.; Miller, T.; Chiang, T. (Department of Physics and Materials Research Laboratory, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801). *Physical Review [Section] B: Condensed Matter;* 37: No. 8, 3996-3998(15 Mar 1988). Contract AC02-76ER01198.

A novel photoemission technique is applied to examine the growth behavior of Ag on Ni(100) and Ni(111) substrates at room temperature. Adsorbed CO molecules are used to label the part of the Ni substrate surface not covered by Ag. From the measured photoemission intensity of the CO molecular orbitals, the area not covered by Ag is determined. The result shows that the growth is close to being layer by layer for the first 0.7 monolayer of Ag coverage, and deviates appreciably from the layer-by-layer mode at higher coverages.

29209 **Ferromagnetism and antiferromagnetism of 3d-metal overlayers on metals.** Bluegel, S.; Weinert, M.; Dederichs, P.H. (Institut fuer Festkoerperforschung der Kernforschungsanlage Juelich, D-5170 Juelich, Federal Republic of Germany). *Physical Review Letters;* 60: No. 11, 1077-1080(14 Mar 1988).

We report systematic calculations based on the full-potential linearized augmented-plane-wave method for the whole transition-metal series (V,Cr,Mn,Fe,Co,Ni) as overlayers on the Pd(001) surface. An energy analysis shows that Fe, Co, and Ni overlayers favor the ferromagnetic p(1 x 1) configuration, but V, Cr, and Mn, the antiferromagnetic c(2 x 2) superstructure. We conjecture that this result is a general trend which should also be found on the (001) surfaces of Pt and the noble metals.

29210 **Superconductivity in primitive hexagonal germanium.** Martins, J.L.; Cohen, M.L. (Department of Physics, University of California at Berkeley, Berkeley, California 94720). *Physical Review [Section] B: Condensed Matter;* 37: No. 7, 3304-3307(1 Mar 1988).

We present a first-principles calculation of the electron-phonon coupling constant λ (mass enchancement parameter) for the primitive hexagonal, high-pressure structural phase of Ge (75 GPaapprox. <papprox. <105 GPa). Using the calculated value of λ, we estimate the superconducting transition temperature T/sub c/ to be in the range of 2 to 7 K. We discuss the contributions to λ from the different phonon modes and its dependence on the phonon frequency, electron-phonon matrix elements, and Fermi-surface nesting. The results are compared with previous calculations for primitive hexagonal Si.

29211 **Suppression of heavy fermions by high fields in $CeCu_6$.** Stewart, G.R.; Andraka, B.; Quitmann, C.; Treadway, B.; Shapira, Y.;McNiff, E.J. Jr. (University of Florida, Gainesville, Florida 32611). *Physical Review [Section] B: Condensed Matter;* 37: No. 7, 3344-3348(1 Mar 1988).

Measurement of the specific heat of $CeCu_6$ in fields to 24 T between 1.8 and 8 K and of the magnetization in fields to 20 T at 1.3 and 4.2 K is reported. The value of γ (= CT) in 24 T is 350 mJmol K^2. The slope of the CT-vs-T^2 data, proportional to the Debye temperature, in 24 T is the same as that for $LaCu_6$ in zero field, with no low-temperature upturn in the CT data in 24 T observed. These data indicate that we achieve complete suppression of the heavy-fermion ground state in $CeCu_6$ with this high applied magnetic field. These results are in sharp contrast with results on uranium systems, indicating a fundamental difference in the heavy-fermion ground state. Implications for de Haas-van Alphen experiments are discussed.

29212 **Surface mechanical properties of C implanted Ni.** Nastasi, M.; Hirvonen, J.; Jervis, T.R.; Pharr, G.M.; Oliver, W.C. (Los Alamos National Laboratory, Materials Science and Technology Division, Los Alamos, New Mexico 87545). *Journal of Materials Research;* 3: No. 2, 226-232(Mar 1988). Contract AC05-76OR00033;AC05-84OR21400.

Nickel foils, 165 μm thick, have been carbon implanted at 300 K with 2, 3, and 4.2 x 10/sup 17/ C ions/cm/sup 2/ and implanted with a two-step implantation of 2.1 x 10/sup 17/ C/cm/sup 2/ at 300 K followed by 2.1 x 10/sup 17/ C/cm/sup 2/ at 77 K. All implantations performed at 300 K result in the formation of the metastable phase Ni/sub 3/C while the two-step implantation produces an amorphous Ni/C alloy. Surface mechanical property studies showed that both the surface hardness and wear properties are correlated with chemistry (carbon dose), and that the friction coefficient is additionally dependent on the surface microstructure. It was found that both the wear rate and coefficient of friction were reduced as the volume fracion of Ni/sub 3/C increased. At the highest dose implanted, 4.2 x 10/sup 17/ C/cm/sup 2/, the coefficient of friction was found to be lower for the sample implanted half at 300 K and half at 77 K and possessing an amorphous structure compared to the sample implanted entirely at 300 K and possessing a crystalline Ni/sub 3/C structure. Increases in the surface

hardness were also observed with increasing carbon content, with the greatest hardness observed in samples implanted to a total dose of 4.2 x 10/sup 17/ C/cm/sup 2/. The hardness at this dose was not dependent on the implant conditions or the metastable phase formed.

29213 **Defect-cluster formation in high-energy-density cascades in gold.** Jaeger, W.; Merkle, K.L. (Argonne National Lab., IL (USA); Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Festkoerperforschung; Argonne National Lab., IL (USA)). *Philosophical Magazine, A: Defects and Mechanical Properties;* **57**: No. 3, 479-498(Mar 1988).

Defect-cluster formation in Au following room-temperature atomic (Bi^+) and diatomic (Bi_2^+) heavy-ion irradiation at low energies (10 and 20 keV $atom^{-1}$, respectively) has been investigated by transmission electron microscopy. The microscopic analysis showed mainly clustering of vacancies into dislocation loops under all conditions investigated. At low doses the fraction of visible cascade events increased with increasing energy and energy density. Evaluation of the size distributions indicated a more efficient separation of self-interstitial atoms and vacancies in denser cascades. Cluster depth distributions were compared with calculated damage distributions and with vacancy distributions obtained from MARLOWE computer simulations. Experimental and calculated distributions are in reasonable agreement for monatomic projectiles; diatomic projectiles led to much greater average cluster depths. This new effect, first observed in Au, has also been found in Si and Ge, which indicates that it is a rather general phenomenon under such conditions. At higher doses the interaction of cascades with preformed defect structures led to an increase of the average size of vacancy loops as saturation was approached at a cluster density of about 10^{14} cm^{-3}.

29214 **Fatigue-crack propagation behaviour of ASTM A533-B steel tested in vacuo at LWR operating temperatures.** James, L.A. (Westinghouse Electric Corp., West Mifflin, PA (USA). Bettis Atomic Power Lab.). *Nuclear Engineering and Design;* **105**: No. 2, 243-253(Jan 1988). Contract AC06-76FF02170.

The fatigue-crack propagation (FCP) behavior of ASTM A533-B-1 steel was characterized in vacuo at 288/sup 0/C. Tests were conducted at two stress ratio: R=0.05 and R=0.7. Results of these tests were compared with results from previous studies for the same type of steel tested in an air environment, and FCP rates in in vacuo were generally lower than those in air. Stress ratio effects in vacuo were not as great as those in air, and both stress ratio effects and environmental effects are discussed from the standpoint of crack closure concepts.

29215 **(UCRL-Trans—12209) Solubility of aluminum, silicon, iron and nickel in the γ, β and α modifications of uranium.** Khakimova, D.K.; Virgil'ev, Y.S.; Ivanov, O.S. (Lawrence Livermore National Lab., CA (USA)). Jan 1988. Contract W-7405-ENG-48. Translated from "Stroenie I Svoistva Splano Urana, Toriya i Tsirkoniya," Gosatomizdat, 1963, pp. 5-8. 7p. NTIS, PC A02/MF A01.

The goal of the present work was a determination of the solubilities of aluminum, silicon, iron and nickel in industrial uranium and improvement of the uranium part of the phase diagram of the corresponding binary systems in connection with this. For this we investigated alloys containing up to 10 at. % alloying elements. All the alloys were melted in an arc furnace in an atmosphere of chemically pure argon. 4 figs.

29216 **(ORNL/tr—88/5) Expert opinion concerning the evaluation of the cast material GGG 40 with regard to its suitability for CASTOR-type shipping and storage casks.** (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. Translation of Document No. BAM 1.2 - H.A. 1.02/3022 - T.A. 1.20/12521, March 14, 1982. 28p. NTIS, PC A03/MF A01.

Cast material GGG40, a nodular cast iron-carbon material in which the carbon present in the form of graphite occurs mostly in a largely spherical form, is discussed. The mechanical properties and fracture mechanics of the material and castings, with regard to safety standards and evaluation of shipping and storage containers, is addressed. 16 refs. (CBS)

29217 **Dynamic response of a thin disk subjected to a thermal pulse.** Calder, C.A.; Cornell, R.H. (Oregon State Univ., Corvallis (USA); Lawrence Livermore National Lab., CA (USA)). *Experimental Mechanics;* **27**: 352-358(Dec 1987).

The dynamic response of a thin steel disk to a transient thermal pulse induced by a pulsed neodymium-glass laser was studied experimentally and compared with numerical results from a finite-element code. The experiment was designed to provide data for evaluation of a disk sample configuration for proposed erosion and corrosion experiments using laser deposition. 11 references.

29218 **Investigation of conventional super-conductivity in ternary cerium compounds through high-pressure studies.** Athreya, K.S. Ames, IA; Iowa State Univ. (1986). 92p. University Microfilms Order No. 87-03,684.Contract W-7405-ENG-82.

Thesis (Ph. D.).

This investigation focuses on the nature and mechanism of superconductivity in the cerium-containing ternary borides and silicides: $CeRu_3B_2$, $CeOs_3B_2$, and $CeRu_3Si_2$. These are the only ternary cerium compounds where conventional (as opposed to heavy-fermion) superconductivity has been observed to date. The closely related crystal structures (all related to the $CeCo_3B_2$√ type, P6mmm) enabled the study of the effect on superconductivity of transforming continuously from one system to the other by going across the pseudo-ternary series Ce (Ru/sub 1-x/Os/sub x/)$_3$B$_2$ and CeRu$_3$√ (B/sub x/Si/sub 1-x/)$_2$. These pseudo-ternary systems were subjected to high external pressures using a standard hydrostatic pressure clamp for lower pressures (up to 20 kbar) and a specially designed diamond anvil cell for higher pressures (up to 66 kbar). Trends are presented for the variation of the superconducting transition temperatures with changes in external pressure. Results are also included from measurements of static magnetic susceptibility and electrical resistivity of all of the materials in the series Ce(Ru/sub 1-x/Os/sub x/)$_3$B$_2$ and CeRu$_3$(B/sub x/Si/sub 1-x/)$_2$. These provide some insight into the nature of the cerium valence in these compounds.

3602 Ceramics, Cermets, And Refractories

REFER ALSO TO CITATION(S) 29294, 29718

29219 **(AD—244270/5/XAB) Research study to determine the phase-equilibrium relations of selected metal carbides at high temperatures.** Dolloff. (Union Carbide Corp., Parma, OH (USA)). Jul 1960. 22p. NTIS, PC A03/MF A01.

Distribution limitation now removed.

29220 **(BNL—40926) Theory of oxygen kinetics in YBa_2Cu_3O/sub 7+-x/.** Bakker, H.; Westerveld, P.A.; Welch, D.O. (Brookhaven National Lab., Upton, NY (USA); Amsterdam Univ. (Netherlands). Natuurkundig Lab.). 1988. Contract AC02-76CH00016. 2p. (CONF-880206—1). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88007391/JAW.

From International conference on high temperature superconductors and materials and mechanisms of superconductivity; Interlaken, Switzerland (29 Feb 1988).

We focus on factors which control oxygen diffusion in the CuO planes of 1-2-3-structure crystals: the availability of vacancies, the vacancy migration energy, the correlation factor, and a thermodynamic factor due to the nonideal concentration dependence of the oxygen chemical potential. 5 refs., 3 figs.

29221 **(BNL—40934) Effects of metal substitutions (Fe and Ga) in $YBa_2Cu_3O_7$ on its superconducting properties and microstructures.** Xu, Youwen; Moodenbaugh, A.R.; Sabatini, R.L.; Suenaga, M. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 3p. (CONF-880408—4). NTIS, PC A02. Order Number DE88007393/JAW.

From Spring meeting of the Materials Research Society; Reno, NV, USA (4 Apr 1988).

A systematic microstructural study of $YBa_2Cu_3O_7$ as functions of the amounts of the replacement elements, Fe and Ga, was undertaken. A series of $YBa_2(Cu/sub\ 1-x/M/sub\ x/)_3O_7$ where M = Fe or Ga and x ≦ 0.1 were prepared using a standard powder-sintering technique, and these specimens were characterized using x-ray powder diffractometry, resistive and inductive techniques for determining T/sub c/, and transmission electron microscopy. Results from the Fe-containing series are nearly complete. Preliminary data only is available for the Ga-containing case. Results of the measurements, T/sub c/ (inductive), the resistivity rho(300K), the rate of drop in rho, (d rhodt), and the lattice parameters are listed. 6 refs., 2 figs., 1 tab.

29222 **(DOE/ER/45117—2) [High temperature corrosion of ceramics].** Blachere, J.R. (Pittsburgh Univ., PA (USA)). 22 May 1986. Contract FG02-84ER45117. 70p.

The ceramics being studied consist of different purities of SiC, Si_3N_4, Al_2O_3 and SiO_2. These particular materials were selected to include ceramics such as Al_2O_3 and SiO_2 which may be considered less reactive in some environments than SiC and Si_3N_4 and forms as protective layer on SiC and Si_3N_4 and superalloys. The effect of purity on the high temperature corrosion performance of these ceramics is being studied because data in the literature indicates that purity of the ceramic will be a significant parameter affecting corrosion behavior, and the fabrication of ceramics hardware currently involves substantial levels of impurities. The experimental approach is to study the corrosion of the ceramics first in certain gases, namely, air, SO_2-O_2, CO_2-O_2, and H_2O-O_2 mixtures and then in these same gas mixtures but with deposits of Na_2SO_4, Na_2CO_3 or Na(OH). Objectives are to describe corrosion of the ceramics in these gases and then incorporate into the models the added effects of deposits. The temperature range covered extends from 700 to 1400{degree}C. The lower temperature limit has been selected since liquid deposits such as sulfate mixtures are formed on hardware used in combustion environments. The upper temperature limit has been selected since it is the peak temperature at which any of the metallic alloys may be exposed on even an intermittent basis. 24 figs., 5 tabs.

29223 **(EGG-M—27286) Advanced ultrasonic NDE methods for characterizing porosity in SiC.** Kunerth, D.C.; Telschow, K.L. (EG and G Idaho, Inc., Idaho Falls (USA)). 1986. Contract AC07-76ID01570. 6p. (CONF-870505—7).

From 32. international gas turbine conference and exhibition; Anaheim, CA, USA (31 May 1987).

Ultrasonic techniques are being developed to detect and characterize porosity in advanced ceramic materials. The techniques use the acoustic backscatter resulting from the porosity or other anomalies and the ultrasonic signal timing and energy characteristics corresponding to propagation velocity and signal amplitude. Although all of the techniques are acoustic in nature, different signal processing algorithms provide different information about the porosity distribution. Four techniques are presented as well as experimental results from a sample of silicon carbide having a known porosity distribution. Information obtained from radiography and microscopic optical examination are compared with the ultrasonic results. 6 refs., 6 figs.

29224 **(LBL—24263) Vacancy ordering in the basal plane of YBa_2Cu_3O/sub z/.** Wille, L.T.; Berera, A.; de Fontaine, D.; Moss, S.C. (Lawrence Berkeley Lab., CA (USA)). Nov 1987. Contract AC03-76SF00098. 5p. (CONF-871124—94). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004572/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

The ordering in the Cu-O basal plane of the high T/sub c/ superconductor YBa_2Cu_3O/sub z/ is investigated. Asymmetric pairwise interactions between nearest and next nearest neighbors are assumed. Ordering instabilities in two-dimensional k-space are mapped out as a function of the interactions and the ordered ground state superstructures consisting of occupied and empty oxygen sites are determined. A temperature-composition phase diagram is calculated by means of the Cluster Variation Method. The thermodynamic behavior of the superconducting compound is discussed in the light of these results. 4 figs.

29225 **(N—88-16868) Nondestructive evaluation of structural ceramics by photoacoustic microscopy. Final report.** Khandelwal, P.K. (General Motors Corp., Indianapolis, IN (USA)). Jun 1987. 110p. (NASA-CR—180858; NAS—1.26:180858; EDR—12815). NTIS, PC A06/MF A01.

A photoacoustic microscopy (PAM) digital imaging system was developed and utilized to characterize silicon nitride material at the various stages of the ceramic fabrication process. Correlation studies revealed that photoacoustic microscopy detected failure initiating defects in substantially more specimens than microradiography and ultrasonic techniques. Photoacoustic microscopy detected 10 to 100 micron size surface and subsurface pores and inclusions, respectively, up to 80 microns below the interrogating surface in machined sintered silicon nitride. Microradiography detected 50 micron diameter fracture controlling pores and inclusions. Subsurface holes were detected up to a depth of 570 microns and 1.00 mm in sintered silicon nitride and silicon carbide, respectively. Seeded voids of 20 to 30 micron diameters at the surface and 50 microns below the interrogating surface were detected by photoacoustic microscopy and microradiography with 1 percent x-ray thickness sensitivity. Tight surface cracks of 96 micron length x 48 micron depth were detected by photoacoustic microscopy. PAM volatilized and removed material in the green state which resulted in linear shallow microcracks after sintering. This significantly limits the use of PAM as an in-process NDE technique.

29226 **(N—88-17796) Friction and wear of monolithic and fiber reinforced silicon-ceramics sliding against IN-718 alloy at 25 to 800 C in atmospheric air at ambient pressure.** Deadmore, D.L.; Sliney, H.E. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Feb 1988. 31p. (NASA-TM—100294; E—3942; NAS—1.15:100294). NTIS, PC A03/MF A01.

The friction and wear of monolithic and fiber reinforced Si-ceramics sliding against the nickel base alloy IN-718 at 25 to 800 C was measured. The monolithic materials tested were silicon carbide (SiC), fused silica (SiO_2), syalon, silicon nitride (Si_3N_4) with W and Mg additives, and Si_3N_4 with Y_2O3 additive. At 25 C fused silica had the lowest friction while Si_3N_4 (W,Mg type) had the lowest wear. At 800 C syalon had the lowest friction while Si_3N_4 (W,Mg type) and syalon had the lowest wear. The SiC/IN-718 couple had the lowest total wear at 25 C. At 800 C the fused silica/IN-718 couple exhibited the least total wear. SiC fiber reinforced reaction bonded silicon nitride (RBSN) composite material with a porosity of 32 percent and a fiber content of 23 vol percent had a lower coefficient of friction and wear when sliding parallel to the fiber direction than in the perpendicular at 25 C. The coefficient of friction for the carbon fiber reinforced borosilicate composite was 0.18 at 25 C. This is the lowest of all the couples tested. Wear of this material was about two decades smaller than that of the monolithic fused silica. This illustrates the large improvement in tribological properties which can be achieved in ceramic materials by fiber reinforcement. At higher temperatures the oxidation products formed on the IN-718 alloy are transferred to the ceramic by sliding action and forms a thin, solid lubricant layer which decreases friction and wear for both the monolithic and fiber reinforced composites.

29227 **(N—88-17802) Tribology of ceramics: Report of the Committee on Tribology of Ceramics.** (National Materials Advisory Board (NRC), Washington, DC (USA)). 1988. 117p. (NASA-CR—182506; NAS—1.26:182506; NMAB—435). NTIS, PC A06/MF A01.

The current state of knowledge of ceramic surface structures, composition, and reactivity is reviewed. The tribological requirements of advanced mechanical systems now being deployed (in particular, heat engines) exceed the capabilities of traditional metallic-based materials because of the high temperatures encountered. Advanced ceramic materials for such applications are receiving intense scrutiny, but there is a lack of understanding of the properties and behavior of ceramic surfaces and the influence of processing on the properties of ceramics is described. The adequacy of models, ranging form atomic to macro, to describe and to pre-

dict ceramic friction and wear are discussed, as well as what is known about lubrication at elevated temperatures. From this analysis, recommendations are made for coordination, research, and development that will lead to better performance of ceramic materials in tribological systems.

29228 **(NAGRA-NTB—88-04) Borehole sealing material properties of highly compacted bentonite with a judgement to its suitability.** Brenner, R.P. (Electro-Watt Engineering Services Ltd., Zurich (Switzerland)). (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Jan 1988. 79p. (In German). Nagra, CH-5401 Baden, Switzerland.

This report first summarizes past investigations and presently available data on highly compacted Na-bentonite (MX-80) and Ca-bentonite (Montigel). The information has been collected mainly from research work reported from Sweden and Switzerland. Then the suitability of Ca-bentonite with respect to its use as a sealing material in boreholes for low and medium level nuclear waste repositories is evaluated. The comparison of the two bentonites with respect to the characteristics relevant for sealing showed that most properties differ only little. This applies particularly to the swelling pressure and the permeability which may be considered the most important properties for sealing materials. The most significant difference is in the plasticity, with MX-80 having a much higher liquid limit than Montigel. The long-term stability is similar for both materials. However, with a groundwater rich in Ca^{2+}-ions, Montigel is preferred, because ion-exchange is minimized and also the tendency for illitization is decreased. Based on the present knowledge, it can be concluded that highly compacted bentonite is a suitable material for a borehole plug. Its function will mainly be that of a highly impermeable barrier. In particular, it has been possible to convincingly establish the suitability of the Ca-bentonite Montigel in Ca^{2+}-rich groundwater. (author) 59 refs., 16 figs., 10 tabs.

29229 **(SAND—88-0047C) Structural studies on La/sub 2/CuO/sub 4+δ/.** Morosin, B.; Jorgensen, J.D.; Schirber, J.E.; Venturini, E.L.; Ginley, D.S. (Sandia National Labs., Albuquerque, NM (USA); Argonne National Lab., IL (USA)). 1988. Contract AC04-76DP00789. 4p. (CONF-880408—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88006828/JAW.

From Spring meeting of the Materials Research Society; Reno, NV, USA (4 Apr 1988).

This preliminary study reports on detailed diffraction investigations underway to establish the structural properties of La/sub 2/CuO/sub 4/. Though not completely analyzed, these spectra illustrate changes in the apparent cell dimension with oxygen treatment and show the lattice symmetry changes must be small and subtle. 7 refs., 1 fig., 1 tab.

29230 **Changes in fracture surface composition and morphology with time in vacuum in YBa/sub 2/Cu/sub 3/O/sub 7-//sub x/.** Kroeger, D.M.; Brynestad, J.; Padgett, R.A. (Metals and Ceramics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6116). *Applied Physics Letters;* **52**: No. 15, 1266-1267(11 Apr 1988). Contract AC05-84OR21400.

Changes in fracture surface composition and morphology with time after fracture in a high vacuum environment are observed in the high transition temperature oxide superconductor YBa/sub 2/ Cu/sub 3/ O/sub 7-//sub x/. Morphological changes involving several grains and extending over distances of tens of microns are seen. Changes in fracture surface morphology are, at least in some cases, preceded by changes in surface composition as determined from Auger electron spectroscopy, and can occur at room temperature in the absence of electron beam excitation.

29231 **Specific heat of single crystals of $YBa_2Cu_3O_7$√/sub δ/: Fluctuation effects in a bulk superconductor.** Inderhees, S.E.; Salamon, M.B.; Goldenfeld, N.; Rice, J.P.; Pazol, B.G.; Ginsberg, D.M.; Liu, J.Z.; Crabtree, G.W. (Department of Physics and Materials Research Laboratory, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801). *Physical Review Letters;* **60**: No. 12, 1178-1180(21 Mar 1988). Contract W-31-109-ENG-38.

Gaussian fluctuations have been observed in the specific heat of two single crystals $YBa_2Cu_3O_7$√/sub δ/. Deviations from a BCS-type step are well accounted for by 3D Gaussian fluctuations whose amplitude ratio, in the cleaner sample, implies that the number of order-parameter components is 7 +- 2. This result is inconsistent with an O(2) Ginzburg-Landau theory.

29232 **Thermodynamics of oxygen ordering in YBa_2Cu_3O/sub z/.** Wille, L.T.; Berera, A.; de Fontaine, D. (Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, Berkeley, California 94720;Department of Physics, University of California, Berkeley, California 94720;Department of Materials Science and Mineral Engineering, University of California, Berkeley, California 94720). *Physical Review Letters;* **60**: No. 11, 1065-1068(14 Mar 1988). Contract AC03-76SF00098.

The ordering in the Cu-O basal plane of YBa_2Cu_3O/sub z/ is investigated as a function of oxygen content and temperature. A phase diagram is calculated by application of the cluster variation method to an asymmetric two-dimensional Ising model. The interaction parameters selected guarantee the stability of the experimentally observed double-cell structure around z = 6.5. The transition temperatures at various oxygen partial pressures are in good agreement with experiment. The pair probabilities along the Cu-O chains show a plateau with varying oxygen concentration, not unlike the dependence of T/sub c/ on oxygen content.

29233 **Evidence for a common high-temperature superconducting effect in La/sub 1.85/Sr/sub 0.15/CuO_4 and $YBa_2Cu_3O_7$.** Jean, Y.C.; Kyle, J.; Nakanishi, H.; Turchi, P.E.A.; Howell, R.H.; Wachs, A.L.; Fluss, M.J.; Meng, R.L.; Hor, H.P.; Huang, J.Z. (University of Missouri--Kansas City, Kansas City, Missouri 64110). *Physical Review Letters;* **60**: No. 11, 1069-1072(14 Mar 1988).

We report the positron-annihilation lifetime and Doppler-broadening energy spectra in La/sub 1.85/Sr/sub 0.15/CuO_4 superconductors for 10<T<297 K. A strong temperature dependence in positron lifetime and momentum distribution parameters is observed for positron-electron annihilation data while the sample is in the superconducting state, but not while it is in the normal state. We show experimental evidence that the superconducting mechanisms in La/sub 1.85/Sr/sub 0.15/CuO_4 and $YBa_2Cu_3O_7$ are similar and suggest that this is a consequence of a common physics involving the delicate balance between localized and itinerant-electron behavior.

29234 **Spin-fluctuation-induced superconductivity in YBa_2Cu_3O/sub 6.9/.** Bedell, K.S.; Pines, D. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *B: Condensed Matter;* **37**: No. 7, 3730-3733(1 Mar 1988).

We show that, independent of the choice of values for the carrier concentration n and specific heat in the normal state, existing experiments on the superconducting properties of polycrystalline YBa_2Cu_3O/sub 6.9/ are consistent with calculations carried out in the clean limit. We find, for a wide choice of n, a substantial exchange enhancement of the Pauli susceptibility. For $n<5 \times 10^{21}$ cm^{-3}, long wavelength spin fluctuations, with a characteristic temperature, T/sub SF/{similar←to}600 K, can give rise to a strong-coupling superconducting transition to a triplet Balian-Werthamer phase. On the other hand, if $n>10^{22}$ cm^{-3} antiferromagnetic spin fluctuations must be invoked if the pairing is of magnetic origin.

29235 **Interaction of H_2O with a high-temperature superconductor.** Qiu, S.L.; Ruckman, M.W.; Brookes, N.B.; Johnson, P.D.; Chen, J.; Lin, C.L.; Strongin, M.; Sinkovic, B.; Crow, J.E.; Jee, C. (Brookhaven National Laboratory, Upton, New York 11973). *Physical Review* [*Section*] *B: Condensed Matter;* **37**: No. 7, 3747-3750(1 Mar 1988). Contract AC02-76CH00016.

The effect of water on the high-temperature superconductor $YBa_2Cu_3O_7$ has been studied. Photoemission measurements show that water modifies valence-band states, reduces the number of inequivalent Ba sites and induces O 1s corelevel components at 534 and 531 eV. The 534-eV core-level component is coincident with

that of cryosorbed ice and the enhanced 531-eV component is due to a new water-induced bonding environment in the superconductor;this is most probably a hydroxyl species. Changes in the Ba core-level appearance suggest that water may be preferentially modifying YBa_2CuO_7 in a way that affects the Ba atomic environment. The effect of water on superconductivity and its possible implications for bulk superconducting transport in ceramics is discussed. Previous reports suggesting oxygen dimerization below T/sub c/, as well as other reported changes in the spectrum, are improbable in view of these present results.

3606 Other Materials

REFER ALSO TO CITATION(S) 28915, 28920, 29292, 29328, 29357, 29358

29236 (AD-A—188288/5/XAB) Electrical properties of Fe-doped semi-insulating InP after proton bombardment and annealing. Woodhouse, J.D.; Donnelly, J.P.; Iseler, G.W. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 1988. 5p. (JA—5997). NTIS, PC A02/MF A01.

Pub. in Solid-State Electronics, Vol. 31, No. 1, 13-16(1988).

The effects of proton bombardment and subsequent 30-min annealing on the electrical properties of semi-insulating InP doped with Fe have been measured for proton doses and for annealing temperatures from 80 to 750 C. Proton bombardment decreases the sheet resistivity. The sheet resistivity is further decreased by annealing at temperatures up to 200-250 C but is increased by annealing at higher temperatures. Semi-insulating behavior is restored by annealing at 450 C or above. These changes can be explained by the formation of donor and acceptor defects at relative rates that vary with proton dose and by the removal of these defects at relative rates that vary with annealing temperature, although a variation in the effectiveness of the Fe acceptors or a hopping contribution to the conductivity may also play a role.

29237 (AD-A—189030/0/XAB) Experimental and analytical investigation on a proposed embedded fiber-optic displacement sensor. Research and development report. Crane, R.; Telegadas, H. (David Taylor Research Center, Bethesda, MD (USA). Ship Materials Engineering Dept.). Nov 1987. 33p. (DTRC/SME—87-95). NTIS, PC A03/MF A01.

Vibration-damping measurements are currently obtained using sensors that measure beam tip displacements by determining the position of the beam cross section with time. In composites, bending-twisting couplings can occur that result in the beam undergoing two-dimensional vibration motion when subjected to a bending moment. A new monitoring technique was conceptualized and validated that utilizes embedded optical fibers as the sensors. This paper discusses the experimental validation of the concept, the physics involved in the optimization of the technique, and the areas in need of further development. The experiments have shown that two dimensional vibration can be detected using this technique. Actual displacement-time information was not available for the specific test apparatus used and therefore damping-loss-factor information was not obtained. Further development of the data-acquisition system and methodology for determination of the image center is required along with an appropriate grid xy sensor in order for the technique to be acceptable as a new technique for measuring the vibration damping loss factors for materials.

29238 (AD-A—189258/7/XAB) Composites strengthening. Final report, 1985-1987. Arsenault, R.J. (Maryland Univ., College Park (USA). Metallurgical Materials Lab.). Nov 1987. 172p. (MML—1987-1). NTIS, PC A08/MF A01.

In all cases of discontinuous silicon carbide/aluminum metal matrix it was previously shown that classical composite strengthening mechanisms could not be used to explain the data. A high-dislocation-density model was proposed to account for the strengthening, but other factors such as residual stress and texture could contribute. These were investigated and it was shown that texture had no effect and residual stress reduced the tensile yield stress. The fracture process is matrix-controlled up to SiC particle sizes of 20 micrometers and above where fracture of SiC begins to dominate. The matrix is influenced by residual hydrostatic tension and high density of dislocations generated at SiC/Al interfaces. Crack-initiation fracture toughness does not depend on SiC particle size. Crack growth fracture toughness increases as the size of the SiC particles increases.

29239 (BNL-NUREG—40842) Effects of chemical and gamma irradiation environments on the mechanical properties of high-density polyethylene (HDPE). Soo, P. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 17p. (CONF-880201—27).

From Waste management '88: symposium on radioactive waste management; Tucson, AZ, USA (26 Feb 1988).

High-density polyethylene (HDPE) is currently being used as a high-integrity container material for low-level wastes. Potential failure/degration modes must be determined for realistic environmental conditions. These include consideration of mechanical stress, gaseous/liquid environments within and external to the container, and the gamma radiation field. A combination of simple inexpensive tests (stressed U-bend samples) and more sophisticated longer-term uniaxial creep tests are being used to define the ranges of conditions for which mechanical failure/degradation is important. Test environments include Igepal CO-630, turbine oil and liquid scintillation fluid as well as air and deionized water, the controi environments. Igepal CO-630 is a surfactant specified in standard ASTM tests for environmental stress cracking. Turbine oil is a possible constituent of low-level waste generated at reactor power plants, and is used in the current tests because of its known detrimental behavior to many types of plastic. Liquid scintillation fluids are being evaluated here because they are representative of the class of organiz solvents containing toluene and xylene. As such they will give valuable insights regarding a type of potential failure or degradation mode for HDPE. The effect of gamma irradiation on crack initiation and propagation is also being studied. A description of the work and results are presented. 8 refs., 6 figs., 2 tabs.

29240 (CBPF-NF—016/86) Fractal nature of the porous structure of tricalcium silicate dry gels. Craievich, A.F. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1986. 15p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702489/JAW.

A small-angle x-ray experimental study of tricalcium silicate (C_3S) porous gel has been carried out by using synchrotron radiation. The scattering data, obtained under optimized experimental conditions, are in remarkable close agreement with the theoretical predictions from a Menger sponge model of porous fractal structure.

29241 (CCMS—87-10) Finite element analysis of damaged cross-ply composite laminates. Strauss, E.A.; Herakovich, C.T. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). Jul 1987. 127p. (VPI-E—87-11). NTIS, PC A07/MF A01.

The problem of transverse cracks in T300/5208 graphite-epoxy cross-ply laminates was studied using generalized plane strain finite element analysis. The degradation of elastic modulus, Poisson's ratio, shear modulus, and coefficient of thermal expansion was predicted and then compared with analytical models and experimental data. The elastic modulus was predicted to exhibit relatively small degradation as a function of crack density as compared to the Poisson's ratio, shear modulus, and coefficient of thermal expansion which were predicted to have large degradations. The resulting state of stress was also studied for several crack spacings. Interlaminar stresses were predicted to form as a result of the free surface of the crack. The crack tip also caused all the nonzero stresses to exhibit singular behavior at the crack tip.

29242 (DOE/ER/45204—T2) New low temperature (hydroxylated) materials: Progress report. Roy, R. (Pennsylvania State Univ., University Park (USA). Materials Research Lab.). Mar 1988. Contract FG02-85ER45204. 12p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88007442/JAW.

The main objective of this research is to synthesize and characterize new low-temperature (below 250°C) hydroxylated or hydrated materials preferably by topotaxy and epitaxy which could serve as useful hosts for immobilization of ions at the typical repository temperatures that are contemplated at present for hazardous

(including nuclear) wastes. Progress is reported in the following areas: synthesis of new hydroxylated phases, cation exchange reactions in these phases, hydrothermal reactions of hydroxylated and hydrated phases with ions, and topotactic replacement of Al by Si in vapors and liquids.

29243 (DOE/ER/45266—1) Crystalline metal-semiconductor superlattices:. Erbil, A. (Georgia Inst. of Tech., Atlanta (USA). School of Physics). 1988. Contract FG05-86ER45266. 13p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88007063/JAW.

The focus of the program in the Phase I period has been the development of underlying science and technology for the fabrication of LaTe/PbTe metal-semiconductor superlattices. The major motivation for this work was to search for excitonic superconductivity in these structures as predicted by theory. Despite recent breakthroughs in the discovery of high-T superconductors, there are still many outstanding problems remaining. Some of the outstanding issues are lack of understanding of the mechanism of high-T superconductivity, difficulty in preparing materials with reproducible properties, requirement for cryogenic cooling, etc. We propose to address these issues. We have discovered a new Y-Ba-Cu-O compound with a transition temperature above 500 K.

29244 (ESA-ESTL—79) Activities report in tribology. Progress report, 1986. Todd, M.J. (European Space Tribology Lab., Risley (UK)). Feb 1987. 15p. (ESA-CR(P)—2477; ETN—88-91423). NTIS, PC A03/MF A01.

Tribological examinations involving lead films, electric contacts, oils and greases, MoS_2 films, and gears are summarized. Data processing and cryogenic tribology are described.

29245 (IC—87/90) Inhomogeneous strain induced by fast neutron irradiation in $NaKSO_4$ crystals. Kandil, S.H.; El Gamal, M.A.; Kassem, M.E.; El Khatib, A.; El Wahidy, E.F. (Alexandria Univ. (Egypt). Dept. of Materials Science; International Centre for Theoretical Physics, Trieste (Italy); Alexandria Univ. (Egypt). Dept. of Physics). (International Centre for Theoretical Physics, Trieste (Italy)). Jun 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702525/JAW.

The effect of fast neutron irradiation on the thermal properties of $NaKSO_4$ crystals was studied around the phase transition temperature T/sub c/=453 K. The thermal expansion coefficient as well as the phase transition temperature were found to be dependent upon the irradiation dose. The specific heat, C/sub p/, showed multiple peaks in the phase transition temperature region. An explanation of this behaviour was based on the induced inhomogeneous strain in the crystal casued by the neutron irradiation process. (author). 10 refs, 3 figs.

29246 (IC—87/91) On the mechanism of DC conductivity in ABS copolymer thin films. Migahed, M.D.; Ahmed, M.T.A.; Hammam, M. (Mansoura Univ. (Egypt). Dept. of Physics). (International Centre for Theoretical Physics, Trieste (Italy)). Jun 1987. 23p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702526/JAW.

Metal-polymer-metal sandwich configuration has been used to investigate the DC conductivity in acrylonitrile-butadiene-styrene (ABS) copolymer. Samples were prepared in the form of thin films of thicknesses in the order of 50 μ by the cast technique. All the measurements have been carried out in atmospheric pressure for temperatures T in the range 290 K $<$ T $<$ 500 K. The applied field intensity was in the range of 10^5Vm. The influence of electrode material (Ag, Al, W) was found to have no effect on the mechanism of conduction in the material. Further, the temporal variation of the current under the influence of temperature and applied field is discussed. All the data presented here show that the conduction mechanism changed from SCLC to a Poole-Frenkel mechanism at different temperatures. (author). 13 refs, 7 figs.

29247 (INIS-BR—1007) Production of polytetrafluoroethylene by means of polymerization induced by gamma radiation. Sugao, A.B. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). 1986. 78p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702591/JAW.

The process of polytetrafluoroethylene (PTFE) production, is studied. The TFE monomer was prepared by pyrolisis of clorodifluoromethane (R-22) and purified by low temperature fractional distillation. The bulk polymerization of tetrafluoroethylene (TFE) induced by gamma rays from a 185 TBq (5000 Ci) Co-60 source was studied at several temperatures (0°C, -23°C e -78°C). The purified monomer was introduced into stainless steel cylindres of 15 and 60 ml under vacuum. Glass cylindres of 10,50 and 700 ml were also used for irradiation at -78°C. The polymer was obtained as white agglomerated particles. The I.R. spectra of polymer samples were consistent with those of commercial PTFE. The melting points of samples were between 327 and 331°C.

29248 (LBL—24145) Specimen cage modification for TEM in-situ shearing. Meike, A. (Lawrence Berkeley Lab., CA (USA)). Nov 1987. Contract AC03-76SF00098. 6p. (CONF-8711100—10). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88007388/JAW.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (30 Nov 1987).

In-situ strain experiments with the electron microscope have contributed substantially to our understanding of deformation in metals and ceramics. However, physical characteristics of rock-forming minerals limit the direct application of experimental procedures developed for metals. The minerals muscovite ($KAl_2(Si_3Al)O_{10}(OH,F)_2$) and biotite (K(MG/sub 0.6-1.8/ Fe/sub 2.4-1.2/) $(Si_3Al)O_{10}$ $(OH,F)_2$) are chosen to develop techniques for preliminary deformation experiments. The present communication describes modifications of sample preparation techniques formicas. The standard tensile straining configuration is altered to a simple shear geometry by means of an intermediary specimen cage to allow the use of a more favorable sample orientation. The extension of the shearing geometry to the in-situ deformation of other rock-forming minerals is discussed. 13 refs., 4 figs.

29249 (LBL—24695) The morphological stability of continuous intergranular phases: Thermodynamic considerations. Carter, W.C. (Lawrence Berkeley Lab., CA (USA)). Dec 1987. Contract AC03-76SF00098. 46p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006328/JAW.

A complete analysis of morphological instability has two components: a thermodynamic analysis identifying the smallest wavelength (infinitesimal amplitude) perturbation for which the amplitude will increase, and a kinetic analysis determining the particular wavelength for which perturbation growth is most rapid. A thermodynamic analysis for nonfaceting surfaces with single-valued interfacial tensions is presented. Possible modifications resulting from surface faceting and the implications of the analysis to the kinetics of phase breakdown have been discussed elsewhere. 29 refs., 4 figs., 2 tabs.

29250 (N—88-16697) Aeropropulsion '87. Session 1: Aeropropulsion materials research. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Nov 1987. 121p. (NASA-CP—10003-SESS-1; E—3798-SESS-1; NAS—1.55:10003-SESS-1). NTIS, PC A06/MF A01.

Topics addressed include: aeropropulsion research and technology impact; high temperature polymer matrix composites; creep and fatigue effects; self-lubricating coatings; and ceramics for engines.

29251 (N—88-16697) Self-lubricating coatings for high-temperature applications. Sliney, H.E. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Nov 1987. vp. (NASA-CP—10003-SESS-1; E—3798-SESS-1; NAS—1.55:10003-SESS-1). NTIS, PC A06/MF A01.

Some present-day aeropropulsion systems impose severe demands on the thermal and oxidative stability of lubricant, bearing, and seal materials. These demands will be much more severe for operational systems around the turn of the century. Solid lubricants with maximum temperature capabilities of about 1100 C are known. Unfortunately, none of the solid lubricants with the highest temperature capabilities are effective below approximately 400 C. However, research shows that silver and stable fluorides, such as calcium and barium fluoride act synergistically to provide lubrication from below room temperature to approximately 900 C. Plasma-sprayed, self-lubricating composite coatings that were developed at Lewis are described. Background information is given on coatings, designed as PS100 and PS101, that contain the solid lubricants in a Nichrome matrix. These coatings have low friction coefficients over a wide temperature range, but they have inadequate wear resistance for some long-duration applications. Wear resistance was dramatically improved in a recently developed coating PS200, by replacing the Nichrome matrix material with metal-bonded chromium carbide containing dispersed silver and calcium fluoride/barium fluoride eutectic (CaF2/BaF2). The lubricants control friction and the carbide matrix provides excellent wear resistance. Successful tests of these coatings are discussed.

29252 **(N—88-16825) Review of thermal properties of graphite composite materials.** Kourtides, D.A. (National Aeronautics and Space Administration, Moffett Field, CA (USA). Ames Research Center). Dec 1987. 52p. (NASA-TM—100049; NAS—1.15:100049; CONF-8710319—). NTIS, PC A04/MF A01.

From Fire Retardant Chemicals Association conference; Monterey, CA, USA (18 Oct 1987).

Flammability, thermal, and selected mechanical properties of composites fabricated with epoxy and other thermally stable resin matrices are described. Properties which were measured included limiting-oxygen index, smoke evolution, thermal degradation products, total-heat release, heat-release rates, mass loss, flame spread, ignition resistance, thermogravimetric analysis, and selected mechanical properties. The properties of 8 different graphite composite panels fabricated using four different resin matrices and two types of graphite reinforcement are described. The resin matrices included: XU71775/H795, a blend of vinyl polystyryl pyridine and bismaleimide; H795, a bismaleimide; Cycom 6162, a phenolic; and PSP 6022M, a polystyryl pyridine. The graphite fiber used was AS-4 in the form of either tape or fabric. The properties of these composites were compared with epoxy composites. It was determined that the blend of vinyl polystyryl pyridine and bismaleimide (XU71775/H795) with the graphite tape was the optimum design giving the lowest heat release rate.

29253 **(N—88-16877) Correlations of norbornenyl cross-linked polyimide resin structures with resin thermo-oxidative stability, resin glass transition temperature and composite initial mechanical properties.** Alston, W.B. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1988. 5p. (NASA-TM—100791; E—3966; NAS—1.15:100791; AVSCOM-TR—88-C-004; CONF-8803103—). NTIS, PC A02/MF A01.

From Multidisciplinary workshop on chemistry and properties of high performance composites; Jackson, WY, USA (28 Mar 1988).

PMR (polymerization of monomeric reactants) methodology was used to prepare 70 different polyimide oligomeric resins and 30 different unidirectional graphite fiber/polyimide composites. Monomeric composition as well as chain length between sites of crosslinks were varied to examine their effects on resin thermo-oxidative stability and glass transition temperature (Tg) of the cured/post-cured resins. A linear correlation of decreasing 316 C resin weight loss/surface area versus (1) decreasing aliphatic content, or (2) increasing benzylic/aliphatic content stoichiometry ratio over a wide range of resin compositions was observed. An almost linear correlation of Tg versus molecular distance between the crosslinks was also observed. An attempt was made to correlate Tg with initial composite mechanical properties (flexural strength and interlaminar shear strength). However, the scatter in mechanical strength data prevented obtaining a clear correlation. Instead, only a range of composite mechanical properties was obtained at 25, 288, and 316 C. Perhaps more importantly, what did become apparent during the correlation study was (1) the PMR methodology could be used to prepare composites from resins containing a wide variety of monomer modifications, (2) that these composites almost invariably provided satisfactory initial mechanical properties as long as the resins formulated exhibited satisfactory processing flow, and (3) that PMR resins exhibited predictable rates of 316 C weight loss/surface area based on their benzylic/aliphatic stoichiometery ratio.

29254 **(N—88-16879) Space environmental effects on polymeric materials. Final technical report, 1 May 1986-31 May 1987.** Kiefer, R.L.; Orwoll, R.A. (College of William and Mary, Williamsburg, VA (USA)). 1987. 31p. (NASA-CR—182454; NAS—1.26:182454). NTIS, PC A03/MF A01.

Polymeric materials that may be exposed on spacecraft to the hostile environment beyond Earth's atmosphere were subjected to atomic oxygen, electron bombardment, and ultraviolet radiation in terrestrial experiments. Evidence is presented for the utility of an inexpensive asher for determining the relative susceptibility of organic polymers to atomic oxygen. Kapton, Ultem, P1700 polysulfone, and m-CBB/BIS-A (a specially formulated polymer prepared at NASA Langley) all eroded at high rates, just as was observed in shuttle experiments. Films of Ultem, P1700 polysulfone, and m-CBB/BIS-A were irradiated with 85 keV electrons. The UV/VIS absorbance of Ultem was found to decay with time after irradiation, indicating free radical decay. The tensile properties of Ultem began to change only after it had been exposed to 100 Mrads. The effects of dose rate, temperature, and simultaneous vs. sequential electron and UV irradiation were also studied.

29255 **(N—88-17743) High-temperature properties of ceramic fibers and insulations for thermal protection of atmospheric entry and hypersonic cruise vehicles.** Kourtides, D.A.; Pitts, W.C.; Araujo, M.; Zimmerman, R.S. (National Aeronautics and Space Administration, Moffett Field, CA (USA). Ames Research Center). Feb 1988. 18p. (NASA-TM—100059; A—88059; NAS—1.15:100059). NTIS, PC A03/MF A01.

Multilayer insulations (MIs) which will operate in the 500 to 1000 C temperature range are being considered for possible applications on aerospace vehicles subject to convective and radiative heating during atmospheric entry. The insulations described consist of ceramic fibers, insulations, and metal foils quilted together with ceramic thread. As these types of insulations have highly anisotropic properties, the total heat transfer characteristics must be determined. Data are presented on the thermal diffusivity and thermal conductivity of four types of MIs and are compared to the baseline Advanced Flexible Reusable Surface Insulation currently used on the Space Shuttle Orbiter. In addition, the high temperature properties of the fibers used in these MIs are discussed. The fibers investigated included silica and three types of aluminoborosilicate (ABS). Static tension tests were performed at temperatures up to 1200 C and the ultimate strain, tensile strength, and tensile modulus of single fibers were determined.

29256 **(PB—88-858832/XAB) Mercury cadmium tellurides (HgCdTe): manufacture, characteristics, and utilization. January 1975-February 1988 (Citations from the INSPEC: Information Services for the Physics and Engineering Communities data base). Report for January 1975-February 1988.** (National Technical Information Service, Springfield, VA (USA)). Mar 1988. 102p. NTIS PC N01/MF N01.

This bibliography contains citations concerning optical and electrical characteristics of mercury cadmium tellurides and their production. Liquid- and vapor-phase epitaxial growth, spectroscopic studies, and the effect of low temperatures on mercury cadmium telluride is discussed. Applications in infrared detectors, laser detectors, and semiconductor devices are examined. (Contains 178 citations fully indexed and including a title list.)

29257 Electrical excitation of flexural mechanical resonances in symmetrically electroded piezoelectric and ferroelectric specimens. Blue, J.E.; Chen, P.J.; Henriquez, T.A.; Ting, R.Y. (Naval Research Laboratory, Underwater Sound Reference Detachment, P.O. Box 568337, Orlando, Florida 32856-8337). *Journal of the Acoustical Society of America;* **83**: No. 4, 1675-1680(Apr 1988).

A clear understanding of the relationship of mechanical and acoustical excitation to electrical output of piezoelectric materials is important in the design of large-area acoustic sensors. Chen [Il Nuovo Cimento 2 D, 1145--1155 (1983)] has reported on electrical excitation of flexural mechanical resonances that are not accompanied by detectable electrical disturbances in the ac drive circuits in a number of different specimens such as X- and Z-cut quartz, Z-cut $LiNbO_3$, ADP, PZTs, $BaTiO_3$, and PLZTs. These observations have raised questions about the understanding of electromechanical interactions. Speculations about the cause of the resonances include the possibility of incompleteness of the constitutive equations of piezoelectricity, surface polarization phenomena, and simple couplings due to slight structural asymmetries. In the latter regard, the objective was to see if the flexural resonances could be easily excited in a Ca-doped $PbTiO_3$ disk having a very small lateral piezoelectric constant ($d_{31} \cong 0.03 d_{33}$) which would tend to minimize the couplings due to slight structural asymmetries. These resonances were also excited in this material.

29258 Distinct states of hydration in thin lyotropic multilayers. Seul, M. (AT & T Bell Laboratories, Murray Hill, New Jersey 07974). *Physical Review Letters;* **60**: No. 12, 1150-1153(21 Mar 1988).

Water adsorption to substrate-deposited, thin multilayers of phospholipids has been probed by high-resolution x-ray scattering. A model of pure displacement disorder in a one-dimensional crystal is applied to analyze the data, and reveals the existence in these films of at least three distinct pure states of hydration. These are characterized by an integer number of monolayers of water associated with each lipid bilayer. Transitions between pure states are similar in nature to staging transitions in intercalation compounds.

29259 Atomic arrangement of sulfur adatoms on Mo(001) at atmospheric pressure: A scanning tunneling microscopy study. Marchon, B.; Bernhardt, P.; Bussell, M.E.; Somorjai, G.A.; Salmeron, M.; Siekhaus, W. (Center for Advanced Materials, Lawrence Berkeley Laboratory, Berkeley, California 94720;Department of Chemistry, University of California, Berkeley, California 94720;and Lawrence Livermore National Laboratory, Livermore, California 94550). *Physical Review Letters;* **60**: No. 12, 1166-1169(21 Mar 1988). Contract AC03-76SF00098.

An ordered monolayer of chemisorbed sulfur adatoms on a Mo(001) surface is imaged in air, by means of scanning tunneling microscopy. The p(2 x 1) overlayer is observed, in agreement with low-energy electron-diffraction studies. The adsorption sites of the sulfur atoms on the molybdenum substrate are clarified, based on the measured corrugation amplitudes. Atomic resolution has also been obtained in the barrier height mode, by use of an ac synchronous detection, and with a better signal-to-noise ratio than in the constant current (topographic) mode.

29260 Spin-wave nonlinear dynamics in an yttrium iron garnet sphere. Bryant, P.; Jeffries, C.; Nakamura, K. (Physics Department, University of California, Berkeley, California 94720). *Physical Review Letters;* **60**: No. 12, 1185-1188(21 Mar 1988).

A high-resolution experiment is reported for spin-wave dynamics in an yttrium iron garnet sphere. For certain parameter values we observe a series of closely spaced spin-wave modes. Interactions between excited modes lead to various dynamical phenomena including auto-oscillations, period-doubling cascades, quasiperiodicity, and chaos. Also observed are irregular relaxation oscillations, abrupt transitions to wide-band turbulence, and hysteresis at the Suhl threshold. A theoretical model is studied analytically and numerically, explaining a number of the experimental behavior patterns.

29261 Interatomic radiative transition rates for the sodium fluoride crystal. Green, T.A.; Jennison, D.R. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Physical Review* [*Section*] *B: Condensed Matter;* **37**: No. 8, 4246-4249(15 Mar 1988). Contract AC04-76DP00789.

Interatomic electric-dipole radiative transition rates for the NaF crystal are calculated for initial 1s, 2s, and 2p holes in the Na^+ ion. The crystal is simulated by a $(NaF_6)^{5-}$ cluster embedded in a large number of point ions, and the one-electron molecular orbitals are obtained from open-shell restricted-Hartree-Fock calculations of the initial state and final states. This allows the transition matrix element to be calculated in the self-consistent-field (ΔSCF) formalism where both initial- and final-state determinantal wave functions are used, and the nonorthogonality of the two sets of molecular orbitals is taken into account. One interatomic radiative transition, the $K\beta_1$ satellite line, has been observed as a high-energy satellite of the Na $K\alpha_1\alpha_2$ line. The measured intensity ratio $\beta_1\alpha_1\alpha_2$ is 1.2 x 10^{-2};our theoretical ratio is 1.13 x 10^{-2}. This level of agreement between theory and experiment is similar to, but somewhat better than, that recently obtained by us for interatomic Auger transitions in NaF, using molecular orbitals from the same calculations. The other interatomic radiative transitions in NaF have considerably smaller transition energies and unobservably small transition rates. The sensitivity of the rates to the choice of Hartree-Fock Gaussian basis set is explored. Rates based on a single determinantal wave function are compared with the ΔSCF rates. The one-center approximation for the $K\beta_1$ rate was found to account for 82% of the rate.

29262 Molecular-dynamics simulations of epitaxial crystal growth from the melt. I. Si(100). Landman, U.; Luedtke, W.D.; Ribarsky, M.W.; Barnett, R.N.; Cleveland, C.L. (School of Physics, Georgia Institute of Technology, Atlanta, Georgia 30332). *Physical Review* [*Section*] *B: Condensed Matter;* **37**: No. 9, 4637-4646(15 Mar 1988).

Liquid-phase epitaxial growth onto a Si(100) substrate is studied using molecular-dynamics simulations. The material is described using two- and three-body interaction potentials which provide a realistic description of crystalline silicon and of the crystal-melt interface. After preparation at solid-melt coexistence, the system is driven out of equilibrium by allowing the conduction of heat to the underlying substrate. Under these conditions the system initially undercools, and subsequently crystallization and growth occur at an overall rate of 18 m/sec, resulting in a perfect crystal. The faceted morphology of the solid-melt interface, characterized by a predominance of (111) microfacets, is maintained throughout the fast-crystallization stage. The dynamics of the crystal-growth process is investigated with refined spatial and temporal resolution via monitoring of real-space particle trajectories and of the evolution of system characteristics such as temperature, potential-energy, and density profiles.

29263 Molecular-dynamics simulations of epitaxial crystal growth from the melt. II. Si(111). Luedtke, W.D.; Landman, U.; Ribarsky, M.W.; Barnett, R.N.; Cleveland, C.L. (School of Physics, Georgia Institute of Technology, Atlanta, Georgia 30332). *Physical Review* [*Section*] *B: Condensed Matter;* **37**: No. 9, 4647-4655(15 Mar 1988).

Molecular-dynamics simulations are employed in studies of liquid-phase epitaxial growth onto a Si(111) surface. The material is described using two- and three-body interaction potentials which provide a realistic description of crystalline silicon and of the crystal-melt interface. From equilibrium solid-melt coexistence, the system is driven out of equilibrium by allowing heat conduction to the underlying substrate. Two heat-extraction rates are used, resulting in growth velocities of 14 and 9 m/sec. The crystal grown under the faster growth conditions contains stacking faults, defective layers, and an amorphous region. The slower growth results in a more perfect crystal with stacking faults and a narrow region of disorder at the solid-vacuum interface. Crystallization is initiated when the crystal-melt interface supercools by {similar←to}150 K and a layer-by-layer growth mode is observed, accompanied by self-annealing processes. The dynamics of the crystal-growth processes are investigated with refined spatial and temporal resolution

using real-space particle trajectories and following the evolution of the system temperature, potential-energy, and density profiles.

29264 **Preparation and melting of amorphous silicon by molecular-dynamics simulations.** Luedtke, W.D.; Landman, U. (School of Physics, Georgia Institute of Technology, Atlanta, Georgia 30332). *Physical Review [Section] B: Condensed Matter;* **37**: No. 9, 4656-4663(15 Mar 1988).

Molecular-dynamics simulations of amorphous silicon are described, using the two- and three-body interaction potentials constructed by Stillinger and Weber. The amorphous-material preparation procedure is described and the structural and dynamical properties of the amorphous phase are simulated and analyzed. The characteristics of the simulated amorphous phase compare favorably with experimental data and with structural models. Upon rapid heating, the amorphous sample melts via a first-order transition at a temperature of 230 K below the melting temperature of the crystalline material with a latent heat approximately equal to 0.2--0.4 of the latent heat of the crystalline-liquid transition. The nature of the transition and the magnitude of the latent heat maintain, but shift to a lower temperature, for melting of fully relaxed amorphous configurations at elevated temperatures.

29265 **Neutron-scattering study of methane bilayer and trilayer films on graphite.** Larese, J.Z.; Harada, M.; Passell, L.; Krim, J.; Satija, S. (Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] B: Condensed Matter;* **37**: No. 9, 4735-4742(15 Mar 1988). Contract AC02-76CH00016.

The results of a neutron-diffraction study of the multilayer growth properties of methane on a graphite substrate are presented. The experiments, performed over an extended temperature range, follow the layering behavior from the submonolayer region to approximately three layers. The completed monolayer film is found to be overcompressed with respect to the bulk value. A stacking sequence and lattice parameter close to that of the bulk solid are found near three layers. The bilayer region, however, is characterized by a diffraction pattern which is not consistent with two layers in perfect registry with one another.

29266 **Network dynamics of chalcogenide glasses. I. Germanium diselenide.** Walter, U.; Price, D.L.; Susman, S.; Volin, K.J. (Materials Science Division and Intense Pulsed Neutron Source, Argonne National Laboratory, Argonne, Illinois 60439-4843). *Physical Review [Section] B: Condensed Matter;* **37**: No. 8, 4232-4239(15 Mar 1988). Contract W-31-109-ENG-38.

The scattering function S(Q,E) of vitreous $GeSe_2$ at 13 K was measured with inelastic neutron scattering over a wide range of variables ($1<Q<8$ A^{-1}, $0<E<45$ meV), with use of a chopper spectrometer at the Intense Pulsed Neutron Source. The data are analyzed in terms of the effective one-phonon density of states G(E), the Q dependence of S(Q,E) at different values of energy transfer E, and the elastic structure factor S/sub el/(Q). The data are discussed in terms of the normal modes of vibration of a $Ge(Se_12)_4$ molecule. Certain features in the data can be unambiguously identified with such modes on the basis of the behavior of the dynamic structure factor S(Q,E) at fixed E. Other features cannot be explained in this way and their understanding must await the development of a detailed microscopic model.

29267 **Network dynamics of chalcogenide glasses. II. Silicon diselenide.** Arai, M.; Price, D.L.; Susman, S.; Volin, K.J.; Walter, U. (Materials Science Division and Intense Pulsed Neutron Source, Argonne National Laboratory, Argonne, Illinois 60439-4843). *Physical Review [Section] B: Condensed Matter;* **37**: No. 8, 4240-4245(15 Mar 1988). Contract W-31-109-ENG-38.

The scattering function S(Q,E) of vitreous $SiSe_2$ at 50 K was measured with inelastic neutron scattering over a wide range of variables ($0.5<Q<12$ A^{-1}, $-20<E<80$ meV), with use of a chopper spectrometer at the Intense Pulsed Neutron Source. The data are analyzed in terms of the effective one-phonon density of states G(E), the Q dependence of S(Q,E) at different values of energy transfer E, and the elastic structure factor S/sub el/(Q). The data are discussed in terms of the normal modes of vibration of a $Si(Se_12)_4$ molecule. Certain features in the data can be generally identified with such modes on the basis of the behavior of the dynamic structure factor S(Q,E) at fixed E. Other features imply more complex structural entities, including edge-linked tetrahedral chains characteristic of crystalline $SiSe_2$ and an admixture of corner-sharing units, not found in the crystal.

29268 **Shifted surface-phonon anomaly in 2H-$TaSe_2$.** Benedek, G.; Brusdeylins, G.; Heimlich, C.; Miglio, L.; Skofronick, J.G.; Toennies, J.P.; Vollmer, R. (Max-Planck-Institut fuer Stroemungsforschung, D-3400 Goettingen, Federal Republic of Germany). *Physical Review Letters;* **60**: No. 11, 1037-1040(14 Mar 1988).

A temperature-dependent soft-mode behavior is found in the surface--Rayleigh-phonon dispersion curve of 2H-$TaSe_2$ by means of inelastic He-atom scattering. The deepest anomaly occurs about 10% below the charge-density-wave onset temperature T/sub o/ = 123 K and is surprisingly located at one-half of the reduced Brillouin zone, unlike the bulk longitudinal-acoustic anomaly which occurs at two-thirds of the zone.

29269 **Optical and EPR investigations of Np^{4+} in single crystals of $ZrSiO_4$.** Poirot, I.; Kot, W.; Shalimoff, G.; Edelstein, N.; Abraham, M.M.; Finch, C.B.; Boatner, L.A. (Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review [Section] B: Condensed Matter;* **37**: No. 7, 3255-3264(1 Mar 1988). Contract AC05-84OR21400.

Polarized optical spectroscopy has been used to investigate the electronic structure of tetravalent neptunium incorporated as a dilute impurity in single crystals of the tetragonal host $ZrSiO_4$. Thirty-one levels were assigned from 30 intense polarized optical transitions and used to obtain a fit to a parametric Hamiltonian to within an rms deviation of 34 cm^{-1}. Thirteen other levels with comparable intensities and good polarization characteristics were observed. Inclusion of these levels using the parameters from the 31-level fit, however, resulted in an increase of the rms deviation to approximately 100 cm^{-1}. The EPR spectra of the ground state of Np^{4+}:$ZrSiO_4$ were measured and fit to an axial spin Hamiltonian to obtain the parameters: {vert←bar}g/sub X/{vert←bar} = 0.8 +- 0.6, {vert←bar}g/sub perpendicular/{vert←bar} = 2.59 +- 0.02, A = -2400 +- 1200 MHz, and B = 4750 +- 30 MHz. These results are consistent with the calculated Γ_6 ground state.

29270 **Combined extended x-ray-absorption fine structure and diffraction study of Kr adsorbed on graphite.** Guryan, C.A.; Lee, K.B.; Stephens, P.W.; Goldman, A.I.; Larese, J.Z.; Heiney, P.A.; Fontes, E. (State University of New York at Stony Brook, Stony Brook, New York 11794-3800). *Physical Review [Section] B: Condensed Matter;* **37**: No. 7, 3461-3466(1 Mar 1988).

We report the results of a combined extended x-ray-absorption fine structure (EXAFS) and x-ray diffraction study of Kr adsorbed on a ZYX graphite substrate. The data are consistent with simple models for atomic fluctuations, which are found to be surprisingly large. Thermal fluctuations weaken the Kr-Kr EXAFS signal, so that the average number of Kr neighbors and the EXAFS Debye-Waller factor cannot be determined independently. The disordered phase at the commensurate-incommensurate transition appears to have substantial local order in the Kr-C signal, consistent with the domain-wall description of that phase.

29271 **Oxidation of TiSi/sub 2/: The role of implanted As and its behavior during oxidation.** Holland, O.W.; Fathy, D.; Withrow, S.P.; Sjoreen, T.P. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Journal of Vacuum Science and Technology, B: Microelectronics Processing and Phenomena;* **6**: No. 2, 569-573(Mar 1988). Contract AC05-84OR21400.

The influence of As/sup +/ ion implantation on the oxidation of TiSi/sub 2/ films was investigated. It is shown that implantation of As leads to a greatly increased rate of oxidation in a dry O/sub 2/ ambient. Oxidation of a silicide implanted with inert Ar/sup +/ ions showed that the effect is not solely due to ion-induced damage but depends on the presence of As in the film. The micros-

tructure of these films, before and after oxidation, was studied using high-resolution transmission electron microscopy and Rutherford backscattering. Also, the morphology of As/sup +/-implanted films after rapid thermal annealing will be discussed. Under certain conditions, the morphology is substantially affected by the implant.

29272 **Monte Carlo simulations of the growth of diamond-structure semiconductors and surface-reflected electron-beam intensities during molecular-beam epitaxy.** Rockett, A. (Departments of Materials Science and Engineering, The Materials Research Laboratory, and The Coordinated Science Laboratory, University of Illinois, Urbana, Illinois 61801). *Journal of Vacuum Science and Technology, B: Microelectronics Processing and Phenomena;* 6: No. 2, 763-766(Mar 1988). Contract AC02-76ER01198.

Monte Carlo simulation results are presented for the growth by molecular-beam epitaxy (MBE) of diamond-structure semiconductors on both specular (001) surfaces and surfaces misoriented by up to 2/sup 0/ from (001) toward (110). The simulation includes calculation of the topography and reconstruction of the surface. Based on the resulting surface structures the streak profile and peak intensity of specularly reflected electron beams are calculated using a kinematic scattering approximation. The results confirm models proposed to explain oscillations observed in the intensity of beams of electrons specularly reflected from terraced surfaces parallel to the terrace edges during MBE. Small clusters of atoms are shown to nucleate on the surface of the terraces and gradually become incorporated into the terrace edges as growth proceeds. On specular surfaces, nucleation occurs randomly followed by growth and coalescence of islands. Stable, statistically random, surface structures are shown to develop leading to an increase in the root-mean-squared roughness of the surface with increasing time. These structures result in a gradual damping of oscillations in the specularly reflected electron beam intensities. The damping rate decreases with increasing surface diffusion and decreasing surface roughness. The strongly bound atomic dimers present on (2 x 1)-reconstructed diamond-lattice (001) surfaces are shown to influence surface diffusion and hence the critical size for nucleation of new surface layers.

29273 **Orthorhombic perovskite CaTiO/sub 3/ and CdTiO/sub 3/: Structure and space group.** Sasaki, Satoshi; Prewitt, C.T.; Bass, J.D.; Schulze, W.A. (State Univ. of New York, Stony Brook (USA). Dept. of Earth and Space Sciences;Pennsylvania State Univ., University Park (USA). Materials Research Lab.). *Acta Crystallographica, Section C: Crystal Structure Communications;* 43: No. 9, 1668-1674(15 Sep 1987).

Structural aspects and physical properties strongly indicate that the CdTiO/sub 3/ perovskite has a centrosymmetric structure with space group Pbnm. Single-crystal X-ray studies have revealed that both CaTiO/sub 3/ and CdTiO/sub 3/ can be described well as GdFeO/sub 3/-type perovskites in terms of the size ratio of two kinds of cation occupying A and B sites. Distortions and tiltings of polyhedra are systematically related to the observed tolerance factor. The crystal data for CaTiO/sub 3/ are: M/sub r/=135.98, Pbnm, a=5.3796(1), b=5.4423(3), c=7.6401(5) A, V=223.68(1) A/sup 3/, Z=4, D/sub x/=4.04 g cm/sup -3/, Mo Kα, λ=0.7107 A, μ=58.0 cm/sup -1/, F(000)=264, T=293 K, R=0.023, 703 unique reflections used for refinements, crystal synthesized at 1470 K and 2.5 GPa. The crystal data for CdTiO/sub 3/ are: M/sub r/=208.30, Pbnm, a=5.3053(1), b=5.4215(3), c=7.6176(3) A, V=219.10(1) A/sup 3/, Z=4, D/sub x/=6.31 g cm/sup -3/, Mo Kα, λ=0.7107 A, μ=130.6 cm/sup -1/, F(000)=376, T=239 K, R=0.019, 829 unique reflections, crystal synthesized at 1470 K and 1.5 GPa.

29274 **Origin of light-induced donors and a model for photodegradation in a-Si:H and a-Si, Ge:H.** McMahon, T.J.; Xi, J.P. (Solar Energy Research Institute, Golden, CO 80401). *AIP (American Institute of Physics) Conference Proceedings;* 157: No. 1, 278-285(25 Jun 1987). (CONF-870116—). Contract AC02-83CH10093.

From International conference on stability of amorphous silicon alloy materials and devices; Palo Alto, CA, USA (28 Jan 1987).

A model is developed from temperature-dependent carrier recombination kinetics for the photodegradation of a-Si:H and a-Si, Ge:H, in which highly strained microscopic regions are the source of the metastable Staebler-Wronski defect. Of the most highly stressed bonds in such regions, possibly only one breaks, creating two dangling bonds and annihilating the safe-trapping characteristic of the entire region within a 15-A radius. Breaking of a strained Si-Si bond in a strained region as opposed to breaking an isolated strained bond has the advantages of (1) reducing the energy required for creating the dangling bonds, (2) allowing for bond separation through a collective relaxation, and (3) explaining the range of activation energies for annealing. With the concept of highly strained regions of safe hole-traps in mind, the hole-trapping mechanism is discussed as a step in the defect-generation mechanism.

40 CHEMISTRY

4001 Analytical And Separations Chemistry

REFER ALSO TO CITATION(S) 29285, 29327, 29403

29275 (DOE/ER—0343, pp 7-10) **Isomeric identification and selective detection of biologically significant organics.** Guerin, M.R.; Buchanan, M.V.; Wise, M.B.; Hettich, R.L. (Oak Ridge National Lab., TN (USA)). 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.). Contract AC05-84OR21400.

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

Progress reported in the development of technologies allowing the unambiguous identification and/or selective detection of trace organics in toxicologically-relevant materials. Issues of particular interest are the quantitative determination of environmental carcinogens and the identification of biomolecule-adducts. Related research supported by the National Cancer Institute focuses on the characterization of environmental tobacco smoke. The studies suggest that negative ionization chemical ionization mass spectrometry may be used to identify polycyclic aromatic hydrocarbons.

29276 (DOE/ER—0343, pp 11-17) **Identification and purification of mutagens from complex mixtures at the one part per billion level.** Felton, J.S.; Knize, M.G.; Shen, N.H.; Healy, S.K. 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.).

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

Progress in the identification of mutagens in prepared food is reported. The principal mutagens studied were aminomethylimidazoazaarenes. The Ames Salmonella assay was used to monitor the chromatographic separation and purification of fried-beef mutagens, saving the mutagenic fractions and further purifying them until pure mutagens are isolated. The purified compound is either identified by using analytical techniques to compare with known compounds, or in the case of the cooked-food mutagens only probable structures could be determined and a series of compounds synthesized to determine which one matched the unknown purified from the extract.

29277 **(IC—87/112) PIXE and AAS comparison in hair analysis for biomedical applications.** Shakir, N.S. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1987. 20p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702546/JAW.

The results of a comparison between PIXE and AAS techniques used for the determination of trace elements in hair for biomedical applications are presented. 6 refs, 9 figs, 6 tabs.

29278 **(IC—87/113) Biomedical application of PIXE. Studies of track elements in human hair, in control and hyperactive children.** Shakir, N.S. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1987. 17p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702547/JAW.

Hair samples from hyperactive and control children have been analyzed for their trace elemental contents by PIXE. The main elements examined are S, K, Ca, Fe, Co, Ni, Cu, Zn, Se, Br,

Hg and Pb. The significant difference between the elements in control population and in patients suffering from pathological conditions are examined. Investigations of the possible linear and multiple correlations between elements in each population are made. The work indicates that some elements do exhibit variation with pathological state. (author). 5 refs, 5 figs, 6 tabs.

29279 **(IEN-DIAPQ—04/84) Calculation of the a_0 value of the unitary cell of garnets.** Baptista, N.R. (Instituto de Engenharia Nuclear, Rio de Janeiro (Brazil)). Jun 1984. 9p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702557/JAW.

The calculation of the a_0 (Angstrom) reticular constant of four samples of garnets, collected in the States of Minas Gerais, Espirito Santo and Bahia, in Brazil, is presented. The objective of this calculation is to determine the molecular composition of samples to complete other experimental studies. (M.C.K.).

29280 **(INIS-mf—11661) Neutron activation analysis in trace element determinaton in studies of wound healing and in the framework of dose-effect studies on platinum-containing cancer chemotherapeutics.** Trebert Haeberlin, S. (Technische Univ. Muenchen (Germany, F.R.). Fakultaet fuer Chemie, Biologie und Geowissenschaften). 21 Feb 1986. 197p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88753298/JAW.

The origin of the iron concentration in wound tissues was studied. To differentiate between blood and tissue iron the erythrocytes of a rabbit were marked with radioactive /sup 55/Fe. Under the assumption that the half-life of rabbit erythrocytes of 34.5 days would not be changed by /sup 55/Fe marking, the /sup 55/Fe activity found in samples taken from the wound area of muscle cut wounds in a healing time of up to 14 days should be a measure for the blood iron share in the wound. The total iron content was determined be measuring /sup 59/Fe with the help of NAA. The portion of iron which was from the tissues was found as the difference between total iron (NAA) and blood iron (/sup 55/Fe). The activation analysis of the samples from the wound tissues was supposed to give information about the participation of other essential trace elements in wound healing. In the framework of the development of new cancer chemotherapeutics with a specific effect on hormone-dependent mammary carcinoma, the distribution of the respective medications in tumor tissues and organs of rats and mice based on the activation analysis determination of platinum content in tissues of interest was ascertained. In the activation analyses for platinum determination the amounts in the samples of other essential trace elements was also determined, in order to ascertain characteristic accumulation or reduction of trace elements in various tissues as a result of tumor development or in connection with therapy.

29281 **(LA—11191) Comparative evaluation of DHDECMP [dihexyl-N,N-diethylcarbamoyl-methylphosphonate] and CMPO [octylphenyl-N,N,-diisobutylcarbamoylmethylphosphine oxide] as extractants for recovering actinides from nitric acid waste streams.** Marsh, S.F.; Yarbro, S.L. (Los Alamos National Lab., NM (USA)). Feb 1988. Contract W-7405-ENG-36. 15p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88007154/JAW.

Certain neutral, bifunctional organophosphorous compounds are of special value to the nuclear industry. Dihexyl-N,N-diethylcarbomoylmethylphosphonate (DHDECMP) and octylphenyl-N,N-diisobutylcarbamoylmethylphosphine oxide (CMPO) are highly selective extractants for removing actinide and lanthanide elements from nitric acid. We obtained these two extractants from newly available commercial sources and evaluated them for recovering Am(III), Pu(IV), and U(VI) from nitric acid waste streams of plutonium processing operations. Variables included the extractant (DHSECMP or CMPO), extractant/tributylphosphate ratio, diluent, nitrate concentration, nitrate salt/nitric acid ratio, fluoride concentration, and contact time. Based on these experimental data, we selected DHDECMP as the perferred extractant for this application. 18 refs., 30 figs.

29282 **(PB—88-171434/XAB) Single-laboratory evaluation of SW-846 Methods 7090/7091 determination of beryllium by flame and furnace atomic absorption spectrophotometry. Summary report January-August 1987.** Hodge, V.F.; Darby, D.A.; Thompson, W.E.; Jones, C.L. (Nevada Univ., Las Vegas (USA). Quality Assurance Lab.). Feb 1988. 140p. (QAL—168). NTIS, PC A07/MF A01.

The results of a single-laboratory study of the Determination of Beryllium by Flame and Furnace Atomic Absorption Spectrophotometry, are described. The study examined the application of these two powerful beryllium detection methods to the analysis of selected liquid and solid samples after digestion by appropriate SW-846 methods. Method performance data including detection limits, optimum concentration ranges (linearity), spike recoveries, interferences, precision, accuracy, and optimum operating parameters are presented and discussed.

29283 **Structures of cis- and trans-dichloroethenes adsorbed on Pt(111).** Grassian, V.H.; Pimentel, G.C. (Department of Chemistry and Chemical Biodynamics Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Journal of Chemical Physics;* **88**: No. 7, 4478-4483(1 Apr 1988). Contract AC03-76SF00098.

The structures of cis-1,2- and trans-1,2-dichloroethene (DCE) adsorbed on the Pt(111) surface have been examined by electron energy loss and thermal desorption spectroscopies over the temperature range 110 to 300 K. For monolayer and submonolayer coverages, the DCEs form sigma bonds to the platinum surface and assume staggered, alkane-like structures. Cis-DCE gives the gauche isomer with its most intense EEL peaks at 650 and 2985 cm/sup -1/ , while the trans-DCE gives the trans conformer with its most intense peaks at 720 and 3000 cm/sup -1/. Isomerization does not occur. On warming to 160 K, the multilayer desorbs and above 200 K, dehalogenation occurs. A prominent EEL peak around 290 cm/sup -1/ shows that the chlorine atoms remain bonded to the surface. For both cis- and trans-DCE, the remainder of the EEL spectrum is that of C/sub 2/H/sub 2/ bonded to the surface in an olefinic structure signaled by prominent peaks at 770--785 and 3010--3020 cm/sup -1/.

29284 **GC/matrix-isolation/FTIR as a complementary technique to GC/MS in characterizing organics in waste.** Schneider, J.F.; Raphaelian, L.A.; Hansen, M.C. (Argonne National Lab., IL (USA)). pp 197-199 of 194. National Meeting of American Chemical Society, Division of Environmental Chemistry. Washington, DC; American Chemical Society (1987). (CONF-870802—).

From 194. American Chemical Society national meeting; New Orleans, LA, USA (30 Aug 1987).

GC/IR is being applied to a variety of analytical problems. The analysis of fossil fuels by GC/IR has been reported elsewhere using the light-pipe type interface. This method suffers from a lack of sensitivity, particularly with the high molecular weight compounds which are of interest in fossil fuel analysis. Gas chromatography/matrix-isolation/Fourier transform infrared spectroscopy (GC/MI/FTIR) has sensitivity for all compounds in a range similar to that of GC/MS. Because absorption frequencies are dependent upon molecular structure, infrared spectroscopy has the specificity to distinguish among isomers that are difficult to differentiate by GC/MS. GC/MI/FTIR freezes the GC effluent in an argon matrix. Each sample component is matrix isolated on the gold-plated mirror surface of a rotatable carrousel. This allows for the FTIR analysis of each component of a complex mixture to be performed after collection with the high sensitivity and specificity of matrix-isolation FTIR detection. The combination of both GC/MI/FTIR and GC/MS gives the analyst the ability to identify trace components of complex mixtures much more completely than either technique can achieve separately.

4002 Inorganic, Organic And Physical Chemistry

REFER ALSO TO CITATION(S) 28824, 28845, 28846, 28847, 28848, 28849, 28850, 28851, 28852, 28857, 28953, 29323, 29429, 29430, 29541, 29601

29285 (DOE/ER—0343, pp 3-6) **Isolation and detection of toxic chemicals.** Guerin, M.R. (Oak Ridge National Lab., TN (USA)). 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.).

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

This summary session reports the development of methods capable of identifying and/or selectively detecting chemicals at the isomeric level in trace quantities. The synthesis of specialty organic and biochemicals for use in studies relating chemical structure with biological activity is reported.

29286 (DOE/ER—0343, pp 40-42) **Preparation of DNA adducts for chromatin and chemical characterization studies, using freshly isolated rat hepatocytes.** Dankovic, D.A.; Springer, D.L.; Thomas, B.L.; Mann, D.B.; Bean, R.M. (Pacific Northwest Lab., Richland, WA (USA)). 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.).

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

This paper describes the results of experiments investigating the amount of DNA adduct formation and the HPLC profile of the Benzo[a]pyrene (BAP)-DNA adducts obtained using freshly isolated rat hepatocytes incubated with CT-DNA. These HPLC profiles were compared to those isolated from the skins of mice treated with BAP in vivo. The HPLC profiles of the adducts prepared using isolated rat hepatocytes plus exogenous calf-thymus DNA were essentially identical to the profiles of mouse skin adducts; in all cases, the predominant peak was the benzo[a]pyrene-anti-diol-epoxide adduct of deoxyguanosine. Preliminary experiments have also been carried out to establish conditions for the preparation of 7,12-dimethylbenzanthracene (DMBA) adducts, using isolated rat hepatocytes plus CT-DNA. Although optimal conditions have not yet been established, the covalent binding of 42-72 pmol DMBA per mg DNA has been observed, and the HPLC profile of the DNA adducts is similar to that observed in vivo, in mouse skin. The preliminary results using BAP and DMBA are therefore satisfactory, and it is anticipated that this method will prove useful for other PAH as well.

29287 (DOE/ER—0343, pp 91) **New route to adducts of nucleotides with carcinogenic aromatic amines.** Underwood, G.; Price, M.; Shapiro, R. (New York Univ., NY (USA)). 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.).

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

Investigations of carcinogen-DNA adducts in the aromatic amine series have been severely hampered by the lack of appropriate synthetic routes to these adducts. Adducts of acetylaminobiphenyl to guanine C-8 that were previously synthetically inaccessible have been prepared in high yield by a new synthetic route. N-hydroxy-4-acetylaminobiphenyl has been reacted with 2,6 dichlorobenzoyl chloride to produce the corresponding hydroxamic acid ester. Unlike the acetate ester, which undergoes acyl oxygen scission, this analog reacts in aqueous solution with nitrenium ion formation. When reacted with deoxyguanosine, good yields of an adduct are produced in which the nitrogen of the biphenylamido moiety forms a covalent bond to the C-8 position of guanine. In this manner, the analogous adducts of d(CpG), d(GpC) and d(ApG) have also been synthesized. Treatment of these adducts with NaOH in methanol results in removal of the acetyl group, thus providing access to both the acetyl and desacetyl derivatives from one precursor.

29288 (DOE/ER—0343, pp 101-103) **Characterization of hemoglobin-benzo[a]pyrene adducts.** Haugen, D.A.; Myers, S.R. (Argonne National Lab., IL (USA)). 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.). Contract W-31-109-ENG-38.

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

Cultures of Syrian hamster embryo (SHE) cells were supplemented with human Hb (0.2 mM heme) and [^{3}H]BP (1 μM). After a 24-h incubation, the medium was removed and subjected to cation-exchange liquid chromatography (CM-Sepharose) to resolve hemoglobins from serum proteins in the medium. The BP-treated Hb was subjected to analysis in each of three column chromatographic systems established for isolation and characterization of human hemoglobin and its genetic and post-translationally modified variants. Results demonstrate that hemoglobin-carcinogen adducts can be resolved from native hemoglobin by established conventional and high-performance liquid chromatographic procedures, suggesting the basis for development of general approaches for isolating and characterizing hemoglobin-carcinogen adducts. The results also suggest the basis for a model system in which adducts between carcinogens and human hemoglobin are formed in cultures of mammalian cells or tissues.

29289 (DOE/ER/10381—9) **Surface composition-reactivity relationships in heterogeneous catalysis: Final report.** Brenner, A. (Wayne State Univ., Detroit, MI (USA). Dept. of Chemistry). 25 Nov 1987. Contract AC02-79ER10381. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006679/JAW.

There were three objectives to this research program, listed below in order of priority. (1) Prepare and determine the activity of well dispersed and low valent catalysts of supported base metals. (2) Determine the activity for H/sub 2/-D/sub 2/ exchange of some transition metals and oxides. (3) Develop the concept of reactive characterization to see if it can be used to assess the morphology of catalysts containing very small metal ensembles. This report contains a brief summary of results for the period March 1985 through September 1987. Limited background information is also provided to indicate the rationale for the experiments. 67 refs., 10 tabs.

29290 (DOE/PC/80518—T10) **Surface chemistry of model Co-Mo catalysts supported on planar γ-Al_2O_3:.** Sahin, T.; Ford, W.K. (Montana State Univ., Bozeman (USA)). 1988. Contract FG22-85PC80518. 8p.

We have done some TPD work on our planar model catalysts and a planar aluminium oxide support. Benzene did not adsorb on a planar alumina surface significantly. Benzene adsorbed on the sulfied planar Co-Mo model catalysts significantly and the desorption starts at 450 K. We could not get enough information from this set of data due to evaporated of SiO_2 on the catalyst surface from the electrical insulation sleeves which accidentally contacted the tungsten filament.

29291 (IC—87/99) **Vibrational analysis of the Raman spectra of selenium oxide dihalides.** Pandey, A.N.; Singh, D.R.; Sharma, D.K. (International Centre for Theoretical Physics, Trieste (Italy); Meerut Coll. (India). Dept. of Physics; Department of Science and Tech., New Delhi (India)). (International Centre for Theoretical Physics, Trieste (Italy)). May 1987. 19p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702534/JAW.

The vibrational analysis of the Raman spectra of selenium oxide dihalides has been performed in the Wilson FG matrix framework. The force constants, vibrational mean amplitudes, bond orders and bond polarizability derivatives have been evaluated. The results have been used to elucidate the nature of chemical bonds. The bond polarizability derivatives are expected to provide useful data required in the interpretation of intensities of Raman lines whenever available. In addition to this the characteristic nature of vibrational mean amplitudes are also examined in selenyl halides and related thionyl halides. (author). 30 refs, 4 tabs.

29292 (IC—87/104) **Soliton and polaron dynamics in conducting polymers.** Su Zhaobin; Yu Lu. (Academia Sinica, Beijing, BJ (China). Inst. of Theoretical Physics). (International Centre for Theoretical Physics, Trieste (Italy)). May 1987. 20p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702539/JAW.

Solitons and polarons in conducting polymers are strongly coupled electron-lattice excitations. The lattice relaxation theory generalized by us to include the self-consistency of multi-electron states with lattice symmetry-breaking is summarized. The discrete symmetries and corresponding selection rules for both radiative and nonradiative processes are discussed. Theoretically calculated probability of nonradiative decay of an electron-hole pair into a soliton pair and that of electron (hole) into polaron as well as the probability of soliton pair photo-generation is compared with results of numerical and laboratory experiments. The resonance Raman scattering data of cis-polyacetylene are interpreted in terms of a bipolaron model. The parameters involved are determined directly from experimental data. Other applications of lattice relaxation theory to conducting polymers are briefly mentioned. (author). 40 refs, 5 figs.

29293 **(IS-T—1297) Characterization, kinetics and mechanisms of electron transfer reactions of superoxochromium(III) ion and a cobalt(II) macrocyclic complex with various substrates.** Brynildson, M.E. (Ames Lab., IA (USA)). Nov 1987. Contract W-7405-ENG-82. 234p. NTIS, PC A11/MF A01; 1; GPO Dep. Order Number DE88007613/JAW.

Chapter 1 describes the kinetics and mechanism of the decomposition of CrO_2^{2+}. Two decomposition pathways are proposed. The first consists of a bond homolysis, $CrO_2^{2+} \rightarrow Cr^{3+} + O_2$, and the second pathway a bimolecular reaction between two CrO_2^{2+} ions to form $HCrO_4^-$. Chapter 2 describes the oxidation-reduction reactions of CrO_2^{2+} with various outer- and inner-sphere reductants. Chapter 3 describes the characterization of $(H_2O)_2Co(dmgBF_2)_2$ by various instrumental and chemical techniques. The kinetics and mechanism for the reaction of $(H_2O)_2Co(dmgBF_2)_2$ with $(H_2O)_5Fe(OH)^{2+}$ are also discussed. The Appendix describes the characterization, kinetics, and mechanisms of the reactions of $(H_2O)_2Co(dmgBF_2)_2$ with H_2O_2 and t-BuOOH. 49 figs., 20 tabs.

29294 **(IS-T—1302) Generation, properties, and order packing of monodispersed spherical colloid particles of yttrium hydroxy-carbonate: A colloidal route to minimizing voids in ceramics.** Mwesigwa-Kayima, P. (Ames Lab., IA (USA)). Nov 1987. Contract W-7405-ENG-82. 105p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88007633/JAW.

Yttrium hydroxy-carbonate particles were prepared by decomposition of urea in yttrium nitrate solutions. The nucleation and growth were studied in silica-seeded and unseeded systems. Precipitation took place only under neutral conditions. In unseeded systems, homogeneous nucleation yielded 3 x 10^{10} nucleicm^3 while in seeded precipitation enough nuclei were produced to bring the total number of particles to 4 x 10^{10}cm^3. Systems containing at least 4 x 10^{10} seedscm^3 underwent pure heterogeneous precipitation onto the existing seeds. Two diffusion-controlled growth models and the diffusion chronomal analysis were applied to the data of growth rate. Results confirmed the diffusion-controlled particle growth mechanism. Electron diffraction showed the particles to be crystalline. Electrophoresis showed a charge reversal from positive to negative with pH, with an isoelectric point of about 7.4. The chemical composition of the powders was determined to be $Y(OH)CO_3 \cdot H_2O$. Stability of aqueous suspensions was studied as a function of pH. 74 refs., 27 figs., 3 tabs.

29295 **(IS-T—1322) Ruthenium, rhodium, and iridium complexes of thiophene and benzo[b]thiophienes: Models for catalytic hydrodesulfurization.** Huckett, S.C. (Ames Lab., IA (USA)). Nov 1987. Contract W-7405-ENG-82. 191p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE88007614/JAW.

Ru, Rh, and Ir complexes of π-bound thiophene (T) and benzo[b]thiophenes (BTs), which serve as models for the adsorption of thiophenes on hydrodesulfurization (HDS) catalysts, have been synthesized. X-ray structural characterization of [(eta-C_6H_5)Ru(eta^6-BT)]BF_4 is reported. These model complexes react with nucleophiles (H^-, MeO^-, $(MeO_2C)_2CH^-$, EtS^- and phosphines). The BT compounds yield isolable transition metal cyclohexadienyl complexes derived from fused ring aromatic lagands;four isomers of each cyclohexadienyl complex are produced. This isomer of CpRu(BT . H) has been characterized by an x-ray structure determination. The T complexes react with phosphines to produce $[Cp^*Ir(eta^4\text{-}T \cdot PR_3)]^{2+}$. Double nucleophilic addition reactions (H^- and MeO^-) of $[Cp^*Ir(BT)]^{2+}$ and $[Cp^*Ir(3\text{-}MeBT)]^{2+}$ are also discussed. Reaction of either $NaBEt_3H$ or Cp_2Co with $[Cp^*Ir(T)]^{2+}$ results in a $2e^-$ reduction of the Ir complex. This product is identified as $Cp^*Ir(eta^4\text{-}T)$. Both $[CpRu(BT)]^+$ and $[CpRu(3\text{-}MeBT)]^+$ undergo base-catalyzed deuterium exchange of H2 and H7 in $DOHCD_3OD$ solutions which follows the rate law, rate = k[Ru complex][OH^-]. The mechanism is proposed to involve rate-determining proton abstraction from either $[CpRu(BT)]^+$, or $[CpRu(3\text{-}MeBT)]^+$, followed by addition of D^+ from the CD_3OD solvent to give the deuterated BT complex. Heterogeneous reactor studies of deuterium exchange of BT over several HDS catalysts (PbMo/sub 6.2/S_8, 1% Pt-10% Reγ-Al_2O_3, Co/sub 0.25/MoS, and 5% Reγ-Al_2O_3) and γ-Al_2O_3 indicate that BT is activated to exchange at the 2- and 3-positions over the catalysts.

29296 **(IS-T—1344) The synthesis and dimerization of two cross-conjugated trienes: 3-methylene-1,4-pentadiene and 1,2,3-trimethylenecyclohexane: 2, Observation of tetrabutylammonium fluorodithioformate.** Koeplinger, K.A. (Ames Lab., IA (USA)). Nov 1987. Contract W-7405-ENG-82. 205p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE88007350/JAW.

I. 3-Methylene-1,4-pentadiene (2) dimerized at a moderate rate in benzene at 95°C, with the major product being the [4 + 2] dimer, 1,4,4-trivinylcyclohexene (12). A stepwise mechanism is postulated for this dimerization with a resonance stabilized diradical intermediate. The conformationally restricted all cisoid analogue of (2), 1,2,3-trimethylenecyclohexane (7) was also prepared. Monomer (7) was much more reactive towards dimerization than (2). The only product formed was identified as a [4 + 2] dimer. An interpretation of the dimerization results of (2) and (7) in terms of the postulated stepwise diradical mechanism is presented. II. Tetrabutylammonium fluoride (TBAF) reacts with CS_2 to give a red salt which appears to be tetrabutylammonium fluorodithioformate, $[S_2C\text{-}F]^-TBA^+$. This reaction occurs both in acetonitrile and when TBAF is exposed to CS_2 vapor. Evidence includes UV-visible spectra, ^{13}C and ^{19}F NMR, and IR spectra. 50 figs., 7 tabs.

29297 **(LBL—24412) A new (cartesian) reaction path model for dynamics in polyatomic systems, with application to H-atom transfer in malonaldehyde.** Ruf, B.A.; Miller, W.H. (California Univ., Berkeley (USA). Dept. of Chemistry; Lawrence Berkeley Lab., CA (USA)). Aug 1987. Contract AC03-76SF00098. 29p. (CONF-871265—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006350/JAW.

From Faraday discussions; Reading, UK (14 Dec 1987).

A new kind of reaction path model for describing reactions in polyatomic molecular systems is presented, one which is based on the cartesian coordinates of the atoms. Not only does this lead to a simpler treatment of the interaction between the {open←quotes}system{close←quotes} (i.e., the reaction coordinate) and the {open←quotes}bath{close←quotes} (the other degrees of freedom) than earlier reaction path models based on the (curvilinear) steepest reaction path, but in many cases it also provides a more natural description of the dynamics. The resulting Hamiltonian has the standard form of a cartesian {open←quotes}system{close←quotes} linearly coupled to a harmonic {open←quotes}bath{close←quotes}, the dynamics of which is treated in this paper by the basis set method of Makri and Miller. Application to a model of H-atom transfer in malonaldehyde shows that the overall approach - both the cartesian reaction path model and the basis set method treatment of the dynsmics - is quite successful. 20 refs., 1 tab.

29298 **(N—88-15855) Equation of state of condensed materials physical principles and applications.** Vinet, P. (National Aeronautics and Space Administration, Washington, DC (USA)). Jan 1988. 152p. (NASA-TT—20007; NAS—1.77:20007). NTIS, PC A08/MF A01.

It is shown that during a compression experiment the isothermal equation of state of condensed materials, solids or liquids, is of a universal form. This single form can describe very different types of materials, metals, ionic or covalent solids, and van der Waals crystals as well. Some simple analytical expressions are pro-

posed which allow accurate predictions (in the absence of phase transition) of the variations of numerous thermodynamic quantities with volume and temperature, i.e., pressure, isothermal bulk modulus, its partial derivative with respect to pressure, and thermal expansion. Some important applications are investigated: lubricants under pressure and their glassy phase transitions; the effect of pressure on shear moduli in mechanical contacts; and the effect of pressure on melting temperatures. In addition, explanations are given in terms of universality of free energy versus interatomic separation. Especially, the effects of electronic structure and atomic bonding are highlighted.

29299 **(N—88-18343) Study of numerical methods for hyperbolic conservation laws with stiff source terms.** Leveque, R.J.; Yee, H.C. (National Aeronautics and Space Administration, Moffett Field, CA (USA). Ames Research Center). Mar 1988. 24p. (NASA-TM—100075; A—88110; NAS—1.15:100075). NTIS, PC A03/MF A01.

The proper modeling of nonequilibrium gas dynamics is required in certain regimes of hypersonic flow. For inviscid flow this gives a system of conservation laws coupled with source terms representing the chemistry. Often a wide range of time scales is present in the problem, leading to numerical difficulties as in stiff systems of ordinary differential equations. Stability can be achieved by using implicit methods, but other numerical difficulties are observed. The behavior of typical numerical methods on a simple advection equation with a parameter-dependent source term was studied. Two approaches to incorporate the source term were utilized: MacCormack type predictor-corrector methods with flux limiters, and splitting methods in which the fluid dynamics and chemistry are handled in separate steps. Various comparisons over a wide range of parameter values were made. In the stiff case where the solution contains discontinuities, incorrect numerical propagation speeds are observed with all of the methods considered. This phenomenon is studied and explained.

29300 **(NIPER—304) Enthalpies of dilution of dodecyl- and tetradecyl- trimethylammonium bromides in aqueous solutions of sodium bromide at elevated temperatures:.** Lam, A.C.; Archer, D.G. (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). Mar 1988. Contract FC22-83FE60149. 49p.

Enthalpies of dilution of dodecyl- and tetradecyl- trimethylammonium bromides in aqueous sodium bromide solutions have been measured from 323 to 448 K and from 373 to 448 K, respectively. Similar to results with no added electrolytes, the onset of micellization can only be characterized by a critical micelle concentration (CMC0 region of finite size and not by a single CMC. The addition of sodium bromide electrolyte shifts the CMC region to a smaller surfactant molality and reduces its diffuseness. For a given temperature, the midpoint of a CMC region and the total electrolyte molality follow a linear relationship on a log-log scale. The change in critical micelle concentration region with respect to added NaBr concentration was used to calcualte midellar "counterion binding fractions." 23 refs., 5 figs., 6 tabs.

29301 **Green function theory of charge transfer processes in solution.** Newton, M.D.; Friedman, H.L. (Department of Chemistry, Brookhaven National Laboratory, Upton, New York 11973). *Journal of Chemical Physics;* **88**: No. 7, 4460-4472(1 Apr 1988).

By using a Green function Q to characterize the linear response of a dielectric body to electric charges, we obtain a theory for the solvent dielectric contribution to relaxation along the reaction coordinate RC(t) in an electron transfer process. For an electron transfer reaction model, in which the ions are embedded in a dielectric continuum, the theory gives, at $t = 0$, the reorganization free energy derived by Marcus in 1956. For the same model the characteristic time tau/sub Q/ associated with RC(t) is evaluated in terms of the dielectric function ϵ/sub ω/ of the medium. How the rate constant k/sub et/ for an electron transfer process depends on tau/sub Q/ is illustrated for both high-barrier and low-barrier cases by approximating RC(t) as a Smoluchowski process on a potential surface. Applying the theory to a molecular model (charged hard sphere ions in a dipolar hard sphere solvent), treated in the mean spherical approximation for the response at any frequency (Wolynes, 1987), indicates that the effects of the molecular structure of the solvent on tau/sub Q/ are large even if the ion is several times larger than a solvent molecule.

29302 **Accurate three-dimensional quantum scattering calculations for F+H/sub 2/→HF+H.** Zhang, J.Z.H.; Miller, W.H. (Department of Chemistry, University of California and Materials and Chemical Science Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Journal of Chemical Physics;* **88**: No. 7, 4549-4550(1 Apr 1988).

A new approach for carrying out quantum scattering calculations for the fluorine and hydrogen reaction is reported. The method is based on Miller's formulation of reactive scattering (ref.1), and uses the S-matrix version of the Kohn variational principle. (ref.2).(AIP)

29303 **Simultaneous measurement of support, metal, and gas phase temperatures using an in situ IR spectroscopic technique.** Sharma, S.; Boecker, D.; Maclay, G.J.; Gonzalez, R.D. (Univ. of Illinois, Chicago (USA)). *Journal of Catalysis;* **110**: No. 1, 103-116(Mar 1988). Contract FG02-86ER13531.

An in situ infrared technique has been developed and used for the simultaneous measurement of gas phase, support, and metal temperatures. This technique yields more realistic and consistent values for reaction temperatures than gas phase or mechanically attached microscopic surface thermocouples. The technique relies on monitoring the temperature-dependent vibrational frequencies of the catalyst support material during reaction. The support vibrational frequencies are calibrated with temperature. This enables one to determine the support temperature during reaction. A 1% Pt/SiO_2 catalyst using the oscillatory oxidation of CO as a reaction probe was used to understand the nature of heat transfer between the metal and the support. The results show that surface temperature oscillations are in phase with CO_2 formation. The resolution of the technique has been shown to be +/- 7°C, depending on the absorption frequency selected. Actual metal temperatures for a thin Pt film sample were determined by in situ resistivity measurements. In most cases the metal-surface temperature gradient was found to be less than the resolution of the IR technique. 22 references.

29304 **Mechanism of acyl group isomerization in palladium(II) complexes. Development of a catalytic process for the isomerization of carboxylic acid chlorides.** Brumbaugh, J.S.; Sen, A. (Pennsylvania State Univ., University Park (USA)). *Journal of the American Chemical Society;* **110**: No. 3, 803-816(3 Feb 1988). Contract FG02-84ER13295.

Prior to the authors work, the isomerization of the acyl group in Co-$(CO)_4$(COR) and Rh$(PPh_3)_2(CO)_2$(COR) had been briefly reported; however, no mechanistic information was available concerning these systems. Herein, they report the results of their studies on the spontaneous acyl group isomerization in cationic palladium(II) complexes. These studies have also led to the development of a novel palladium-catalyzed process for the isomerization of carboxylic acid chlorides. The latter allows the first experimental determination of the relative free energies of formation for isomeric acid chlorides and, by extrapolation, other isomeric alkyl derivatives.

29305 **Carbon-carbon bond activation via β-alkyl elimination. Reversible branching of 1,4-pentadienes catalyzed by scandocene hydride derivatives.** Bunel, E.; Burger, B.J.; Bercaw, J.E. (California Institute of Technology, Pasadena (USA)). *Journal of the American Chemical Society;* **110**: No. 3, 976-978(3 Feb 1988).

Although impressive advances have recently been made in activating the carbon-hydrogen bonds of hydrocarbons, the activation of carbon-carbon bonds by soluble transition-metal complexes remains one of the most prominent challenges in organometallic chemistry. Since classical approaches to hydrocarbon rearrangements involve acid-promoted carbocation chemistry, the authors have explored the possibility that highly Lewis acidic, early transition-metal alkyls and hydrides could effect C-C bond-forming or -breaking processes for simple hydrocarbons. They report herein that a scandocene hydride complex catalyzes the reversible branch-

ing and cyclization of 1,4-pentadienes. The key feature responsible for this unusual reactivity is reversible olefin insertion/β-alkyl elimination.

29306 **Experimental procedures for the analysis of intraparticle diffusion during temperature-programmed desorption from porous catalysts in a flow system.** Huang, Y.J.; Xue, J.; Schwarz, J.A. (Syracuse Univ., NY (USA)). *Journal of Catalysis;* **109**: No. 2, 396-406(Feb 1988). Contract FG02-87ER13650.

An analog to the Weisz-Prater method is used to analyze the effect of intraparticle diffusion under the nonisothermal conditions of a temperature-programmed desorption (TPD) experiment. By taking into account the temperature-dependent transport properties and the readsorption of the adsorbate, the importance of intraparticle mass transfer during TPD is assessed by the magnitude of the effectiveness factor. Experimental TPD spectra of CO and H_2 from Ni/SiO_2 catalysts serve as prototype examples for desorption of these adsorbates from Group VIII supported metal catalysts. It is found that the observed desorption rate, particle size, surface concentration of the adsorbate, effective diffusivity of the adsorbate in the carrier gas/catalyst particle, catalyst bed volume, heating rate, and initial surface coverage of the adsorbate collectively determine the magnitude of the effectiveness factor. Characteristic plots for first- and second-order desorption, respectively, are presented to guide the experimentalist in selecting the appropriate experimental parameters to minimize the effect of intraparticle gradients during the TPD process. 18 references.

29307 **Distribution of hexamethylbenzene in a zeolite studied by xenon-129 and multiple-quantum NMR.** Ryoo, R.; Liu, S.B.; de Menorval, L.C.; Takegoshi, K.; Chmelka, B.; Trecoske, M.; Pines, A. (Univ. of California, Berkeley (USA)). *Journal of Physical Chemistry;* **91**: No. 27, 6575-6577(31 Dec 1987). Contract AC03-76SF00098.

The distribution of hexamethylbenzene (HMB) molecules among the cavities of a Na-Y zeolite has been investigated by both xenon-129 and multiple-quantum NMR. For samples prepared at 523 K, xenon NMR shows that HMB molecules are dispersed nonuniformly, entering and remaining in the first available zeolite cavities. After further heat treatment at 573 K, the xenon spectrum collapses to one single line characteristic of a macroscopically uniform molecular distribution; multiple-quantum NMR counting indicates spin cluster of about 16 hydrogens, consistent with one HMB (18 hydrogens) per cavity.

29308 **Effects of dilution on the ultraviolet and visible absorptivity of CS_2 under static and shock compression.** Yoo, C.S.; Furrer, J.J.; Duvall, G.E.; Agnew, S.F.; Swanson, B.I. (Washington State Univ., Pullman (USA)). *Journal of Physical Chemistry;* **91**: No. 27, 6577-6578(31 Dec 1987).

A comparison of diamond-anvil cell measurements with results of a time-resolved shock experiment provides the first quantitative evidence of large differences in the electronic processes occurring under conditions of static and dynamic compression. Samples consist of 1% solutions of CS_2 in hexane, and the measurements are of absorption spectra in the range 25,000 to 35,000 cm^{-1}. Static measurements of temperature coefficients show that the spectral differences cannot be due to temperature effects.

29309 **Bending in the CH_2OR radical trapped in crystals of methyl α-D-mannopyranoside as measured by ENDOR.** Bernhard, W.A.; Mercer, K.R. (Univ. of Rochester, NY (USA)). *Journal of Physical Chemistry;* **91**: No. 27, 6592-6595(31 Dec 1987). Contract FG02-85ER60282.

A CH_2OR radical trapped in single crystals of methyl α-D-mannopyranoside has been characterized by ENDOR measurements at 77 K. The highly accurate α-hydrogen tensors are used to calculate the geometry about the free-radical center. The CH_2OR radical is bent with theta = 5.8 +- 0.4°, where theta is the angle between the nodal plane of the lone electron orbital and the three σ bonds (O-C, H-C, H'-C). The three angles H-C-H', O-C-H, and O-C-H' are 127.0 +- 0.4°, 108.0 +- 0.2°, and 122.1 +- 0.2°, respectively. The unpaired electron densities are rho/sub c/ $\approx$ 0.83 and rho/sub o/ $\approx$ 0.17.

29310 **Quantum chemical study of ZnO, Cu/ZnO, Cu_2O, and CuO clusters and CO chemisorption on ZnO(0001), CuZnO(0001), and Cu/ZnO(0001) surfaces.** Rodriguez, J.A.; Campbell, C.T. (Indiana Univ., Bloomington (USA)). *Journal of Physical Chemistry;* **91**: No. 27, 6648-6658(31 Dec 1987).

Copper/zinc oxide mixtures show strong synergistic effects when used together as catalysts, particularly in methanol synthesis and water-gas-shift reactions. The authors have employed semiempirical quantum-mechanical calculations (INDO) to study the electronic properties of ZnO, CuO, and CuO_2 clusters ($\leq$ 26 atoms), of Cu absorbed on or substituted in these ZnO clusters, and of CO chemisorbed on ZnO(0001) and Cu/ZnO clusters. The results are discussed in light of models previously proposed to explain the unique properties of Cu/ZnO catalysts, which often involve Cu^+ impurities in (on) the ZnO lattice. They use mainly the calculated charge on the Cu atom and its interaction with CO to address the electronic properties of Cu substituted in and adsorbed on ZnO clusters. Their results for neutral clusters indicate that, with respect to atomic charge, this Cu is quite similar in nature to the Cu atoms of bulk CuO or the Zn atoms of ZnO, where the metal has a formal oxidation state of +2. The Cu site in these ZnO clusters shows unique electron affinity properties, accepting a major fraction of the added electron density for anionic clusters. The mechanisms of CO chemisorptive bond formation on Cu(100), ZnO(0001), and Cu-doped ZnO are compared and contrasted based on the present results and those in the literature.

29311 **CO methanation and ethane hydrogenolysis over Ni thin films supported on W(110) and W(100).** Greenlief, C.M.; Berlowitz, P.J.; Goodman, D.W.; White, J.M. (Sandia National Labs., Albuquerque, NM (USA)). *Journal of Physical Chemistry;* **91**: No. 27, 6669-6673(31 Dec 1987). Contract AC04-76DP00789.

The kinetics of methanation and ethane hydrogenolysis have been used to probe the surface chemistry of submonolayer amounts of Ni deposited on W(110) and W(100). Ni adsorption up to 1 monolayer is pseudomorphic, and submonolayer films are strained to conform to the W substrate lattice dimensions. Methanation rates per Ni atom on both W substrates are equal to rates found on Ni single crystals and on supported Ni catalysts. From these results the authors conclude that CO methanation is structure insensitive and that the rate-limiting step likely requires no more than one Ni atom. For ethane hydrogenolysis over Ni/W(110), the activation energy was 21.9 +/- 1 kcal mol^{-1} and independent of Ni coverage, but the overall reaction rate (per Ni atom) decreased with increasing Ni coverage. Over Ni/W(100) the activation energy was 22.3 +/- 1 $kcal^{-1}$ and was independent of Ni coverage. The results are consistent with the strained (more open) Ni overlayers being more active toward C-C bond breaking and with only a single, unhindered Ni atom being required for the rate-determining step in ethane hydrogenolysis.

29312 **Ab initio configuration interaction study of the hyperfine coupling in F_2p.** Carmichael, I. (Univ. of Notre Dame, IN (USA)). *Journal of Physical Chemistry;* **91**: No. 26, 6443-6445(17 Dec 1987).

The (^{19}F) magnetic hyperfine interaction tensor in F_2^- is calculated from the spin density distribution obtained through a variational configuration mixing procedure. All spin-adapted configurations arising from single and double replacements in the unrestricted Hartree-Fock determinant within a polarized triple-zeta basis are considered. The estimated isotropic splitting indicates that matrix effects in neon are much smaller than implied from previous spin-restricted calculations. A simple model is used to approximate this environmental shift.

29313 **Geometrical structure of C_3i.** Faibis, A.; Kanter, E.P.; Tack, L.M.; Bakke, E.; Zabransky, B.J. (Argonne National Lab., IL). *Journal of Physical Chemistry;* **91**: No. 26, 6445-6447(17 Dec 1987). Contract W-31-109-ENG-38.

Results of Coulomb explosion experiments are presented which provide the first experimental evidence for the geometrical structure of the small carbon cluster ion C_3^+. These results indicate that the ground state of this molecule forms a bent structure. For

comparison, measurements were also made of the carbon geometries within the molecules $C_3H_3^+$ and $C_3H_4^+$. The former is found to form a predominantly cyclic structure while the latter exhibits a linear geometry in agreement with suggestions of previous experimental and theoretical results.

29314 **Discrimination of grain-size subpopulations in pyroclastic deposits.** Sheridan, M.F.; Wohletz, K.H.; Dehn, J. (Arizona State Univ., Tempe (USA)). *Geology;* **15**: No. 4, 367-370(Apr 1987).

A cubic spline curve fit to histograms of grain-size data from pyroclastic deposits affords a rapid means to distinguish subpopulations in complex size distributions. Using interactive microcomputer graphics, the operator can isolate and quantitatively characterize subpopulations by a method of successive Gaussian subtractions. Percentile measures of the entire size range are not needed, and segments of the whole size distribution can be analyzed independently. Recurrent subpopulations with similar means and standard deviations are consistent among the more than 140 samples of pyroclastic-surge deposits from Sugarloaf in Arizona and Vulcano in Italy. The entire data set can be replicated by synthetic curves consisting of various proportions of five identified Gaussian components, each of which the authors attribute to a specific mechanism of transport and deposition.

29315 **Formation and characterization of polynuclear aluminum species.** Bertsch, P.M.; Anderson, M.A.; Layton, W.J. (Univ. of Georgia, Aiken, SC (USA)). pp 142-143 of 194. National Meeting of American Chemical Society, Division of Environmental Chemistry. Washington, DC; American Chemical Society (1987). (CONF-870802—).

From 194. American Chemical Society national meeting; New Orleans, LA, USA (30 Aug 1987).

This paper examines the evidence in support of various polynuclear aluminum species in aqueous solutions. The results of ferron assays and ^{27}Al NMR methods are discussed. The structure of a symmetrical Al_{13} polymer and its behavior as a function of mole ratio and neutralization rates are described.

29316 **Preparation and characterization of pillared hectorite catalysts.** Occelli, M.L.; Finseth, D.H. (Gulf Research & Development Co., Pittsburgh, PA (USA)). *Journal of Catalysis;* **99**: No. 2, 316-326(Jun 1986).

Reaction of natural hectorite with Al, ZrAl, and Zr polyoxycations generate pillared hectorites which after heating in air at 400°C/4 h have Langmuir surface areas of 260-300 m^2/g thermally stable to 600-700°C. Spectroscopic studies of sorbed pyridine indicate that these pillared hectorites (like pillared bentonites) contain both Lewis and Broensted acid sites distributed as in the parent (acid-washed) hectorite. Above 300°C, in vacuo, pyridine is sorbed mainly on Lewis sites. Pillared hectorites are not as active as the corresponding pillared bentonites in cracking 260-426°C boiling range gas oils but exhibit greater gasoline selectivity and minimize light gases (C_2-C_4) generation. Cracking activity depends mostly on the surface area generated by pillaring and the parent hectorite low iron content did not affect the catalyst's carbon selectivity.

29317 **Preparation of highly dispersed cobalt clusters in zeolites via microwave discharge methods.** Zerger, R.P.; McMahon, K.C.; Seltzer, M.D.; Michel, R.G.; Suib, S.L. (Univ. of Connecticut, Storrs (USA)). *Journal of Catalysis;* **99**: No. 2, 498-505(Jun 1986). Contract AC02-83ER13131.

A microwave discharge has been used to prepare highly dispersed and reduced cobalt metal atom clusters in zeolites and other solid substrates such as alumina, silica, activated carbon, and polymers. Spectroscopic data show that the microwave discharge approach offers several advantages over other activation procedures for the preparation of small metal particles on solid supports. Scanning electron microscopy, ferromagnetic resonance, and X-ray line broadening experiments indicate that these particles are smaller than 30 A. 30 references.

29318 **Chlorine promoters in selective ethylene epoxidation over Ag(111): a comparison with Ag(110).** Campbell, C.T. (Los Alamos National Lab., NM (USA)). *Journal of Catalysis;* **99**: No. 1, 28-38(May 1986).

Chlorine promoters are added in the silver-catalyzed oxidation of ethylene ($C_2H_4 + 1/2\ O_2 \rightarrow C_2H_4O$) in order to improve the selectivity for ethylene epoxide production. The author has recently modeled the role of chlorine promoters in this reaction by depositing chlorine adatoms onto the Ag(110) surface in ultrahigh vacuum (UHV) and monitoring the resultant effects on the medium-pressure (~ 1 atm) kinetics of the epoxidation reaction. This was accomplished with an apparatus that allowed rapid (< 20 s) transfer of the model catalyst between the UHV chamber for surface analysis (XPS, AES, LEED, AES) and a high-pressure microreactor for kinetics. That work led to a detailed picture of the role of chlorine promoters in this reaction. This present study is an extension of that work to include the Ag(111) surface, which behaves much differently than Ag(110) in dissociate oxygen adsorption, but nevertheless displays very similar catalytic behavior for this reaction. The results indicate that the effects of chlorine addition are very similar on Ag(111) and (110). They can be explained with the same reaction mechanism involving adsorbed oxygen and ethylene. The steady-state atomic oxygen coverage (under catalytic reaction conditions) goes through a large maximum with chlorine coverage on Ag(111), not seen with Ag(110). This is due to the very low reactivity of atomic oxygen on Ag(111) in the presence of chlorine. Evidence is presented that suggests that the standard method of measuring the Ag surface area of supported catalysts via oxygen chemisorption is very unreliable.

29319 **Characterization of palladium surfaces with (+)-apopinene: correlation of reaction paths with surface features.** Smith, G.V.; Molnar, A.; Khan, M.M.; Ostgard, D.; Yoshida, N. (Southern Illinois Univ., Carbondale (USA)). *Journal of Catalysis;* **98**: No. 2, 502-512(Apr 1986). Contract AC02-81ER10897.

The molecular probe (+)-apopinene is chosen for the characterization of metal surface sites because of its unique structural features. These features allow clear distinctions of adsorption side and double bond position. By measuring the relative rates of double bond migration and addition, k/sub i/k/sub a/, it is shown that (+)-apopinene is sensitive to 17 different Pd catalyst preparations. Among these, a set of alumina-supported Pd catalysts ranging in dispersions from 0.055 to 1.00 (131 to 8.4 A by EM) yielded results consistent with the notions that ^{3}M-type sites (highly coordinatively unsaturated) catalyze principally addition and ^{2}M-type sites catalyze principally isomerization. (+)-Apopinene distinguishes between reduced PdO_2 samples which have undergone different extents of surface reconstruction. 25 references.

29320 **Reduction of nitric oxide with carbon monoxide on the Rh(100) single-crystal surface.** Hendershot, R.E.; Hansen, R.S. (Iowa State Univ., Ames (USA)). *Journal of Catalysis;* **98**: No. 1, 150-165(Mar 1986).

The reduction of nitric oxide with carbon monoxide has been investigated on the Rh(100) single-crystal surface. Steady-state kinetic measurements, at 688 K and in the pressure range 1.0 to 1800 Pa, indicate that this process proceeds via a Langmuir-Hinshelwood-type mechanism and is selective toward the production of N_2 and CO_2. The carbon monoxide kinetic order varied continuously from +1 to -1 as the partial pressure of CO was increased from 1 to 250 Pa, at a constant NO partial pressure of 57.5 Pa. In a similar manner, the nitric oxide kinetic order varied continuously from +3/2 to -1 as the partial pressure of NO was increased from 1 to 1800 Pa, at a constant CO partial pressure of 44.0 Pa. The catalyst surface was characterized with Auger electron spectroscopy (AES), low-energy electron diffraction (LEED), and thermal desorption spectroscopy (TDS). Initial Auger analysis revealed surface contamination by sulfur, phosphorus, and boron. These contaminants were removed via cycles of argon ion bombardment, reactive ion bombardment, and high-temperature annealing. Nitric oxide adsorbed with a high sticking coefficient and formed a c(2 x 2) ordered overlayer at saturation. The nitric oxide adsorbate dissociated upon slow stepwise heating as indicated by the production of a surface oxide and disappearance of surface nitrogen. Thermal desorption experiments at a faster heating rate indicated, however, that most of the adsorbed nitric oxide desorbed molecularly in a first-order process with a peak at 401 K during the temperature flash. Carbon monoxide adsorbs molecularly in two distinct sites with desorption from both following first-order kinetics with TDS

peaks at 373 and 425 K. A kinetic model was developed which is consistent with both the steady-state kinetic and surface characterization results.

29321 **Solid-state magic-angle spinning ^{27}Al NMR used to study alumina support and surface compound structure of catalysts.** McMillan, M.; Brinen, J.S.; Haller, G.L. (Yale Univ., New Haven, CT (USA)). *Journal of Catalysis;* **97**: No. 1, 243-247(Jan 1986). Contract AC02-81ER10829.

^{27}Al NMR can, in principle, be very useful for following the tetrahedral/octahedral ratio in alumina supports as a function of thermal treatment as has been demonstrated previously. Even with magic-angle spinning of highly crystalline α-alumina (corundum), the NMR linewidth of ^{27}Al is quite broad. This would lead one to surmise that it would not be feasible to observe the formation of surface compounds of the alumina support or active catalytic phases since the NMR signal of the surface phase would be masked by the bulk if the two phases were of comparable linewidth and chemical shift. What the authors demonstrate in this communication is that the surface and bulk phases of alumina need not have the same linewidth and, depending on the surface compounds formed, may have substantial chemical shifts relative to bulk Al^{3+}. In the case of a $NiMoP/Al_2O_3$ hydrodesulfurization catalyst, at least, Al^{3+}-containing surface phases are formed during calcination which can easily be distinguished from the bulk γ-Al_2O_3 support. 27 references.

29322 **Comparison of the single turnover and standard solution phase techniques in alkene deuterations.** Augustine, R.L.; Lenczyk, M.E. (Seton Hall Univ., South Orange, NJ (USA)). *Journal of Catalysis;* **97**: No. 1, 269-271(Jan 1986). Contract FG02-84ER45120.

The Single Turnover (STO) procedure for investigating catalysts and catalytic reactions has been shown to be useful as a means of characterizing dispersed metal catalysts. Beyond that, however, it is also a valuable tool in evaluating catalytic reactions such as the room-temperature deuterium exchange on alkanes as well as determining the effect of competitive adsorption of a solvent in a catalytic hydrogenation. While there is a correlation between the vapor-phase STO results and solution-phase data in comparing hydrogen presaturated and nonpresaturated catalysts in alkene hydrogenation, it was felt that a more definitive comparison between the results obtained using these two techniques was warranted. Since there is an extensive literature concerning the deuterium addition and exchange with alkenes both in the vapor phase and in solution it was considered that this would be an appropriate reaction to use in a direct comparison of a solution-phase catalytic reaction with one run using the STO procedure. The catalysts used were aged 5% Pt/C and 5% Pd/C; the methylcyclopentene was distilled, and degassed before use; and the deuterated ethanol was +99.5 atom% D and was used as received. 7 references.

4004 Electrochemistry

29323 **(DOE/ER/13346—T1) Evaluation of carbon paste electrodes chemically modified by direct admixing of iron-bathophenanthroline complexes:.** Mottola, H.A. (Oklahoma State Univ., Stillwater (USA). Dept. of Chemistry). 1987. Contract FG05-85ER13346. 14p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88007064/JAW.

Work has been focused on the development of three basic types of chemically modified electrodes: (1) Carbon pastes modified by direct admixing of iron complexes with ligands of the 1,10-phenanthroline family. (2) Direct covalent attachment of ligands of the 1,10-phenanthroline family to graphite or to the pasting liquid used for electrode preparation, and subsequent treatment with iron(II). (3) Oxidative electropolymerization of iron complexes with 5-amino-1,10-phenanthroline as ligand. Direct chemical attachment to graphite of 5-amino-1,10-phenanthroline resulted in chemical modification but the amount of electroactive centers per electrode unit surface area was not sufficient to warrant successful application as sensing devices in continuous-flow systems. Oxidative electropolymerization provided successful development of polymeric films (100 to 3000 equivalent monolayers) with fast kinetics of charge transfer across the polymeric film grown on glassy carbon or platinum surfaces. Direct admixing of tris[1,10-phenanthroline] iron(II) perchlorate provided surfaces useful for sensing in flow systems but with the drawback of rather rapid leaching of mediator (iron complex) into the carrier stream. 8 figs., 2 tabs.

29324 **(SAND—85-0027C) Lithium transport in ternary lithium-copper-oxygen cathode materials.** Godshall, N.A. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 8p. (CONF-850870—6). Elsevier Science Publishers, 52 Vanderbilt Ave., New York, NY 10017. Order Number TI88006643/JAW.

From 5. international conference on solid-state ionics; Lake Tahoe, CA, USA (18 Aug 1985).

An understanding of the Li-Cu-O ternary phase diagram was undertaken in order to predict Lithium Copper Oxide battery performance. The slow kinetics of this system are manifested in lower observed open circuit voltages than those predicted thermodynamically, approximately 1.6 to 1.8V versus 2.2 to 2.4V, respectively. Electrochemical titration of both copper (II) oxide and copper (I) oxide resulted in two-plateau discharges. The ternary compound LiCuO was formed during initial discharge of both compounds. The free energy of LiCuO was determined to be -88.3 kcal/mole. The slow kinetics of the initial displacement reaction is discussed in terms of the morphological changes undergone during titration with lithium. 7 figs.

29325 **Electrochemistry of iron oxides: an in situ Moessbauer study.** Fierro, C.; Carbonio, R.E.; Scherson, D.; Yeager, E.B. (Case Western Reserve Univ., Cleveland, OH (USA)). *Journal of Physical Chemistry;* **91**: No. 27, 6579-6581(31 Dec 1987).

The electrochemical properties of $Fe(OH)_2$ dispersed on high-area carbon in strongly alkaline media have been studied in situ by Moessbauer spectroscopy. The oxidation of this material was found to yield either an ensemble of small magnetite particles of different sizes or a mixture of superparamagnetic and bulklike magnetite crystals depending on whether the process was carried out by stepping or sweeping the potential to -0.3 V vs Hg/HgO,OH^-, respectively. This provides clear evidence that the morphological characteristics of the resulting material are determined by the rate at which the oxidation reaction is performed. Further cathodic polarization to -1.2 V gave rise to the irreversible reduction of the $Fe(OH)_2$ to metallic iron.

29326 **Electrochemical time-of-flight experiment.** Feldman, B.J.; Feldberg, S.W.; Murray, R.W. (Western Regional Research Center, Albany, CA (USA)). *Journal of Physical Chemistry;* **91**: No. 26, 6558-6560(17 Dec 1987). Contract AC02-76CH00016.

A novel experiment to measure electron diffusion rates in polymers is based on the time of flight of electrons across a 2.5-μm film of electroactive material sandwiched between generator and collector electrodes in a lithographically defined interdigitated electrode array. The electrons are generated as a concentration pulse of donor or acceptor states at the generator electrode (by transiently manipulating its potential), cross the polymer film by electron self-exchanges, and are detected as a current at the opposing collector electrode. A digital simulation model is used to account for the electron flight time in terms of the electron diffusion rate in the polymeric film and the array geometry.

4005 Photochemistry

29327 **Photochemical reactions of cis- and trans-1,2-dichloroethene adsorbed on Pd(111) and Pt(111).** Grassian, V.H.; Pimentel, G.C. (Department of Chemistry and Chemical Biodynamics Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Journal of Chemical Physics;* **88**: No. 7, 4484-4491(1 Apr 1988). Contract AC03-76SF00098.

The photochemical behaviors of cis- and trans-1,2-dichloroethene (DCE) adsorbed on Pd(111) and Pt(111) surfaces have been studied using electron energy loss spectroscopy (EELS). For multilayer coverage on either metal surface, irradiation of physisorbed DCE at 110 K with broad band irradiation ($\lambda > 200$ nm) results in photoisomerization, cis–trans. For monolayer coverage on

Pt(111) at 110 K, photolysis of chemisorbed DCE causes loss of the two chlorine atoms to form a single hydrocarbon product, chemisorbed acetylene. Apparently, for $\lambda > 237$ nm, the chlorine atoms remain bound to the platinum surface whereas for shorter wavelengths, $\lambda > 200$ nm, the chlorine atoms leave the surface. These results are interpretable in terms of singlet excitation of the chemisorbed alkane followed by chlorine elimination on an excited singlet reaction surface. This study indicates that photochemistry of molecules chemisorbed on a metal surface is possible despite the proximity of the conducting surface. It shows that energy relaxation processes connected with this proximity are not prohibitively fast.

29328 **Observation of a new electronic state of C/sub 2/ by resonance ionization spectroscopy.** Goodwin, P.M.; Cool, T.A. (School of Applied and Engineering Physics, Cornell University, Ithaca, New York 14853). *Journal of Chemical Physics;* **88**: No. 7, 4548-4549(1 Apr 1988).

A study of the resonance enhanced multiple photon (REMPI) spectrum of C/sub 2/(A /sup 1/Pi/sub u/) radicals formed in the two-step photodissociation of C/sub 2/H/sub 2/ at 193 nm has been completed for laser wavelengths from 370 to 480 nm. Rotational analyses for 12 rovibronic bands of two-photon resonant C/sub 2/(1 /sup 1/Δ/sub u/left-arrowA /sup 1/Pi/sub u/) transitions provide preliminary spectroscopic constants for the previously unobserved 1 /sup 1/Δ/sub u/ state.

29329 **Quantum yield of vinylidene ($^3B_2$) from the vacuum UV photolysis of acetylene and ethylene.** Fahr, A.; Laufer, A.H. (National Bureau of Standards (NBS), Gaithersburg, MD (USA). Chemical Kinetics Div.; Department of Energy, Washington, DC (USA). Div. of Chemical Sciences). *Journal of Photochemistry;* **34**: No. 3, 261-266(Sep 1986).

The primary processes in the photodecomposition in the vacuum UV of the unsaturated hydrocarbons acetylene and ethylene have been investigated. The formation of electronically excited triplet vinylidene ($H_2C = C$) radicals is shown to be a major process. The quantum yields of vinylidene production are equal to 0.4 and 0.75 from acetylene and ethylene respectively. Vinyl radical formation in the ethylene photolysis is discussed.

4006 Radiation Chemistry

REFER ALSO TO CITATION(S) 29309, 29521, 29523

29330 **Electron localization in water clusters. I. Electron--water pseudopotential.** Barnett, R.N.; Landman, U.; Cleveland, C.L.; Jortner, J. (School of Physics, Georgia Institute of Technlogy, Atlanta, Georgia 30332). *Journal of Chemical Physics;* **88**: No. 7, 4421-4428(1 Apr 1988).

A local pseudopotential for the interaction of an electron with a water molecule in the electronic ground state is developed. The potential contains Coulomb, adiabatic polarization, exclusion, and exchange contributions. The potential is suitable for a description of excess electron states in water clusers, and for studies of electron solvation in water. Quantum path integral molecular dynamics simulations of electron localization in water clusters employing this potential yield results in agreement with available experimental data and all-electron quantum chemical calculations.

29331 **Electron localization in water clusters. II. Surface and internal states.** Barnett, R.N.; Landman, U.; Cleveland, C.L.; Jortner, J. (School of Physics, Georgia Institute of Technology, Atlanta, Georgia 30332). *Journal of Chemical Physics;* **88**: No. 7, 4429-4447(1 Apr 1988).

Electron attachment and localization in small water clusters (H/sub 2/O)/sub n/ (n = 8--128) is studied using path-integral molecular dynamics simulations. The electron-water molecule interaction is described via a pseudopotential which includes Coulomb, polarization, exclusion and exchange contributions. Different electron localization modes are found depending on cluster size. For small and intermediate size clusters (n = 8--32), the energetically favored localization mode involves a surface state and the calculated excess electron binding energies are in agreement with experimentally measured values. In larger clusters, n = 64, 128, internal localization (solvation) is energetically favored. In both cases the localization of the excess electron is accompanied by large cluster molecular reorganization. The cluster size dependence of the localization mode, the energetics, structure, and excess electron distributions in the negative molecular anions (H/sub 2/O)/sup -//sub n/, and the dependence on temperature are explored.

29332 **ESR and ENDOR studies of radicals produced in hydroxyproline single crystals by X-irradiation at low temperatures. 2.** Nelson, W.H. (Georgia State Univ., Atlanta). *Journal of Physical Chemistry;* **92**: No. 2, 554-561(28 Jan 1988). Contract AS05-83ER60159.

In an extension of previous work, six additional radicals have been detected in crystals of hydroxyproline (NH_3^+C/sub δ/H_2C/sub γ/HOHC/sub β/H_2C/sub α/$HCOO^-$) irradiated at 10 or 65 K. Five of these have been identified, with characteristics as follows. In radical I, the product of decarboxylation, the unpaired electron interacted with five hydrogen nuclei. One of the interactions was from a nonexchangeable α-proton, two were from nonexchangeable β-protons, and two were from easily exchangeable β-protons. Radical I formed at temperatures below 10 K and was stable up to 160 K. In radical II, which was observed to anneal near 20 K, the unpaired electron interacted with two nonexchangeable hydrogen nuclei. On the basis of the characteristics of the couplings, radical II was tentatively identified as the product of electron loss from the side chain, followed by deprotonation at C/sub β/. Radical III, which exhibited four nonexchangeable β-proton interactions, was identified as the product of net hydrogen abstraction from C/sub γ/. Radical III was found after irradiation at 65 K, but not when crystals irradiated at 10 K were warmed. Radical IV, identified as an additional conformation of the deamination radical, was found preferentially (but not exclusively) in deuteriated crystals in the temperature range 77-125 K. In radicals V and VI, the unpaired electron interacted with only one β-proton. Radical V was identified as another conformation of the primary carboxyl anion, but it was not possible to identify radical VI.

29333 **Track effects in radiation chemistry: production of HO_2 in the radiolysis of water by high-LET ^{58}Ni ions.** LaVerne, J.A.; Schuler, R.H. (Univ. of Notre Dame, IN (USA)). *Journal of Physical Chemistry;* **91**: No. 26, 6560-6563(17 Dec 1987).

The yields of HO_2/sup ./ produced in the radiolysis of water by ^{58}Ni ions having energies up to 460 MeV have been determined. For these radiations the differential yields for HO_2/sup ./ production increase from 0.26 to 0.43 molecules100 eV over an LET range of 260-520 eVA. From these measurements a limiting yield of 0.57 molecules100 eV is estimated for HO_2/sup ./ production by energy deposited in the track core at very high LETs. These studies demonstrate the feasibility of carrying out significant radiation-chemical studies with beams of particles having LETs in excess of 200 eVA.

4007 Radiochemistry And Nuclear Chemistry

REFER ALSO TO CITATION(S) 29288, 29475

29334 (DOE/ER—0343, pp 43-45) **Identification of DNA damage in mouse lung after intratracheal instillation of nitroaromatic and polycyclic aromatic hydrocarbons.** Mitchell, C.E.; Martin, O.S.; Bond, J.A. (Lovelace Inhalation Toxicology Research Institute, Albuquerque, NM (USA)). 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.). Contract AC04-76EV01013.

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

DNA alkaline elution, total covalent binding, and DNA adduct formation (using the ^{32}P-postlabeling assay and HPLC) were used to determine the extent of DNA damage after instillation of chemicals. Pretreatment of male mice with benzo(a)pyrene (BaP) (24 hours prior to instillation of labeled compounds) was effective in increasing the binding of chemicals to DNA. Four hours after instillation of [^{14}C]-1-NP, [-^{14}C]dinitropyrene, [^{3}H]BaP, or [^{3}H]-2-aminoanthracene, the amounts of labeled compounds bound to

DNA were 160-, 7.6-, 5.4-, and 5.2-fold above uninduced mice. The amount of 1-NP bound to DNA was 30 times greater than BaP. The average amount of label bound one week later ranged from 43-62% of the activity bound at four hours. Pretreatment with diesel exhaust extract increased only BaP binding, and 1-NP pretreatment did not affect the bound activity. These studies show that different classes of polycyclic aromatic compound metabolites bind to lung DNA and that after induction of lung enzymes, 1-NP is bound much more extensively than other compounds investigated. These studies also indicate that DNA adducts of 1-NP metabolites may be formed in lung (a primary site for inhaled particles), liver and kidney following inhalation of airborne particles containing 1-NP and that both the slower proliferating and rapidly proliferating cells are targets for 1-NP binding. In addition, a significant portion of the DNA adducts may be repaired early whereas other adducts are removed at a slower rate which is similar to that of normal DNA turnover.

29335 **(INIS-mf—11669) Experiments in radioactive marking of lipopoly saccharides in the framework of endotoxin research.** Steinmueller, B. (Freie Univ. Berlin (Germany, F.R.)). 7 Feb 1985. 72p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753304/JAW.

The endotoxin from E. coli was marked using Na-125-iodine, in order to eventually through animal experiments obtain more information about the biological attack site of the endotoxin in the organism. The endotoxin from S. equi served thereby as a reference substance, since more exact information about the structure and degree of purity of this endotoxin is present.

29336 **Initial radiolysis effects on the T_2-O_2 gas reaction.** Failor, R.A.; Souers, P.C.; Prussin, S.G. (Lawrence Livermore National Lab., CA). *Journal of Physical Chemistry;* **92**: No. 2, 429-433(28 Jan 1988). Contract W-7405-ENG-48.

Model calculations were performed to examine the effects of self-radiolysis of pure T_2 on the reaction of T_2 and O_2. The pressure dependence of the steady-state concentrations of the major T_2 self-radiolysis products and the times required to reach steady state are examined in detail. The largest variations from the modeling results obtained by assuming initially pure T_2 and O_2 are found with low total tritium concentrations where self-radiolysis produces the largest T/T_2 concentration ratios. In general, the effects of inclusion of T_2 self-radiolysis effects are important only during the first few seconds following initiation of the $T_2 + O_2$ reaction.

29337 **Synthesis and enzymatic decarboxylation of 6-bromo-L-dopa, a potential brain tracer for L-dopa.** Wong, M.; De Jesus, O.T. (Princeton Univ., NJ (USA);Argonne National Lab., IL (USA);Chicago Univ., IL (USA). Dept. of Radiology). *Journal of Labelled Compounds and Radiopharmaceuticals;* **24**: No. 11, 1373-1380(Nov 1987). Contract W-31-109-ENG-38.

Direct bromination of L-dopa with stoichiometric amounts of molecular bromine was found to yield 6-bromo-L-dopa as the sole product. This determination was made using liquid chromatography with electrochemical detector, mass spectroscopy, and proton NMR. 6-Bromo-L-dopa was found to be a substrate of an isolated decarboxylase enzyme although the rate of decarboxylation was much slower than that for L-dopa. These results suggest that a radiobrominated L-dopa analog may be a suitable PET or SPECT tracer for L-dopa in the brain.

4008 Combustion, Pyrolysis, And High-temperature Chemistry

29338 **(SAND—88-8600) The burning rate of HAN-based [hydroxylammonium nitrate] liquid propellants.** Vosen, S.R. (Sandia National Labs., Livermore, CA (USA)). Feb 1988. Contract AC04-76DR00789. 27p. (CONF-880802—6). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006863/JAW.

From 22. international symposium on combustion; Seattle, WA, USA (14 Aug 1988).

To improve the understanding of the physical processes which occur during the combustion of liquid propellants (LP), a strand burner was used to study hydroxylammonium nitrate-based LP flames. By observing the combustion of LP in such an arrangement, much has been deduced of the physical processes that occur during LP ignition and combustion. Combustion experiments were performed in which mixtures of the salts hydroxylammonium nitrate (HAN) and triethanolammonium nitrate (TEAN) in water were ignited by an electric discharge in a vessel at pressures of up to 30 MPa. Results of experiments conducted during turbulent combustion are: (1) the combustion of HAN-based LP occurs in two stages in which the liquid phase decomposition of HAN is followed by the decomposition of TEAN, (2) the turbulent combustion rate of LP 1846 decreases with increasing pressure. This variation of apparent burning rate with pressure, a result which is not seen in single component propellant combustion, is attributed to changes in the stability of the liquid-gas interface with pressure, and (3) a model of the combustion of HAN-based liquid propellants as it occurs in bulk has been presented, showing the reaction sequence of the components of HAN-based liquid propellants. 14 refs., 9 figs., 1 tab.

42 ENGINEERING

4202 Facilities And Equipment

REFER ALSO TO CITATION(S) 28885, 28923, 28972, 29176, 29216, 29248, 29381, 29439, 29812, 29825

29339 **(DOE/ER/13735—1) Self shielding of surfaces irradiated by intense energy fluxes:.** Howell, J.R.; Varghese, P.L. (Texas Univ., Austin (USA)). Feb 1988. Contract FG05-87ER13735. 17p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88007094/JAW.

This report summarizes work completed to date on the study of the effects of the impingement of a very high fluence plasma onto a target surface. Particular emphasis is placed on self-shielding of the target surface caused by initial surface erosion and the resulting presence of heavy metal ions in an ionsized shield slayer near the surface. A high energy hydrogen plasma will be produced by a rail gun coupled to high-current sources (capacitor banks or high-current pulse homoplar generators developed at the University of Texas at Austin). Because of the extremely fast transients presents in the experiments, considerable instrumentation development in necessary to provide the necessary diagnostic tools for characterizing the incident plasma as well as the transient development of the vapor layer. The experimental results will be used to verify and/or modifify a detailed of the dimensional transient computer code that models the complete plasma-surface interaction history. The model includes the effects of evaporated and sputtered wall material and its inteeraction with the incident plasma.

29340 **(LA—11264-MS) Laser countermeasure impacts and penalties.** Canavan, G.H. (Los Alamos National Lab., NM (USA)). Apr 1988. Contract W-7405-ENG-36. 23p.

Countermeasures could determine the ultimate effectiveness of directed energy weapons. This report discusses shielding and spinning boosters, the countermeasures specific to lasers, and provides an overall assessment of their impact, which is modest. 32 refs., 4 figs.

29341 **Shellside waterflow pressure drop distribution measurements in an industrial-sized test heat exchanger.** Halle, H.; Chenoweth, J.M.; Wambsganss, M.W. (Argonne National Laboratory, Argonne, IL). *Journal of Heat Transfer;* **110**: No. 1, 60-67(Feb 1988). Contract W-31-109-ENG-38.

Throughout the life of a heat exchanger, a significant part of the operating cost arises from pumping the heat transfer fluids through an past the tubes. The pumping power requirement is continuous and depends directly upon the magnitude of the pressure losses. Thus, in order to select an optimum heat exchanger design, it is as important to be able to predict pressure drop accurately as it is to predict heat transfer. This paper presents experimental measurements of the shellside pressure drop for 24 different segmentally baffled bundle configurations in a 0.6-m (24-in.) diameter by 3.7-m

(12-ft) long shell with single inlet and outlet nozzles. Both plain and finned tubes, nominally 19-mm (0.75-in.) outside diameter, were arranged on equilateral triangular, square, rotated triangular, and rotated square tube layouts with a tube pitch-to-diameter ratio of 1.25. Isothermal water tests for a range of Reynolds numbers from 7000 to 100,000 were run to measure overall as well as incremental pressure drops across sections of the exchanger. The experimental results are given and correlated with a pressure drop versus flowrate relationship.

4203 Lasers

29342 **(BNL—40844) Integral equation for the laser field:.** Gallardo, J.C.; Dattoli, G.; Renieri, A.; Hermsen, T. (Brookhaven National Lab., Upton, NY (USA); ENEA, Frascati (Italy). Centro Ricerche Energia). 1987. Contract AC02-76CH00016. 15p. (CONF-8709110—20).

From 9. international free-electron laser conference; Williamsburg, VA, USA (14 Sep 1987).

In the first part of this article we present a one-dimensional multimode theory of a free-electron laser. We show that the evolution of the laser field in a single pass through the undulator satisfies an integral equation. The formulation is exact, describing saturation and both low and high gain regime of a long-pulse free-electron laser. In the second part we derive the laser field evolution equation for an oscillator configuration in the small signal regime and the long pulse limit. The theory is based on the space-time approach that leads to a generalized Schroedinger-like equation for the laser radiation field. The explicit expressions for the solutions of the evolution equation and the gain coefficient of the system are presented;part of these results have already been derived by some of the authors using a different approach. 12 refs.

29343 **(LA—11225-MS) Free electron lasers in strategic defense.** Canavan, G.H.; Browne, J.C. (Los Alamos National Lab., NM (USA)). Mar 1988. Contract W-7405-ENG-36. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88007024/JAW.

This report discusses the basis for free electron laser (FEL) operation, roles FELS could play in strategic defense, expected effectiveness, and status of key components. The constellation sizes needed to meet evolving threats are derived, and the tradeoffs between space and ground basing of FELs are discussed, leading to a conclusion that FELs could be available for and play complementary roles to those of kinetic energy concepts. 41 refs., 4 figs.

29344 **(LA-UR—88-657) Use of magnetic materials in excimer laser circuits.** Vannini, M.; Sze, R.; Hommeau, F. (Institut de Mecanique des Fluides, 13 - Marseille (France); Los Alamos National Lab., NM (USA); Consiglio Nazionale delle Ricerche, Florence (Italy). Ist. di Elettronica Quantistica). 1987. Contract W-7405-ENG-36. 9p. (CONF-871254—8). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88006449/JAW.

From Lasers '87; Lake Tahoe, NV, USA (7 Dec 1987).

The use of saturating magnetic materials in laser excitation discharge systems is presented. Particular attention is given to the most important parameters of magnetic materials and to the analysis of some circuits such as single and multi-stage pulse compressor and pre-pulse isolation systems. 25 refs.,5 figs.

29345 **(N—88-17020) AlGaAs heterojunction lasers. Final report, 28 June 1985-27 June 1986.** Goldstein, B.; Pultz, G.N.; Carlin, D.B.; Slavin, S.E.; Ettenberg, M. (RCA Labs., Princeton, NJ (USA)). Feb 1988. 157p. (NASA-CR—4119; NAS—1.26:4119; RCA-PRRL—87-CR-1). NTIS, PC A08/MF A01.

The characterization of 8300 A lasers was broadened, especially in the area of beam quality. Modulation rates up to 2 Gbit/sec at output powers of 20 mW were observed, waveform fidelity was fully adequate for low BER data transmission, and wavefront measurements showed that phase aberrations were less than lamda/50. Also, individually addressable arrays of up to ten contiguous diode lasers were fabricated and tested. Each laser operates at powers up to 30 mW CW in single spatial mode. Shifting the operating wavelength of the basic CSP laser from 8300 A to 8650 A was accomplished by the addition of Si to the active region. Output power has reached 100 mW single mode, with excellent far field wave front properties. Operating life is currently approx. 1000 hrs at 35 mW CW. In addition, laser reliability, for operation at both 8300 A and 8650 A, has profited significantly from several developments in the processing procedures.

29346 **(N—88-18443) Laser production and heating of plasma for MHD application.** Jalufka, N.W. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). Mar 1988. 11p. (NASA-TP—2798; L—16373; NAS—1.60:2798). NTIS, PC A03/MF A01.

Experiments have been made on the production and heating of plasmas by the absorption of laser radiation. These experiments were performed to ascertain the feasibility of using laser-produced or laser-heated plasmas as the input for a magnetohydrodynamic (MHD) generator. Such a system would have a broad application as a laser-to-electricity energy converter for space power transmission. Experiments with a 100-J-pulsed CO_2 laser were conducted to investigate the breakdown of argon gas by a high-intensity laser beam, the parameters (electron density and temperature) of the plasma produced, and the formation and propagation of laser-supported detonation (LSD) waves. Experiments were also carried out using a 1-J-pulsed CO_2 laser to heat the plasma produced in a shock tube. The shock-tube hydrogen plasma reached electron densities of approximately 10 to the 17th/cu cm and electron temperatures of approximately 1 eV. Absorption of the CO_2 laser beam by the plasma was measured, and up to approximately 100 percent absorption was observed. Measurements with a small MHD generator showed that the energy extraction efficiency could be very large with values up to 56 percent being measured.

29347 **Numerical simulation and experimental studies of longitudinally excited miniature solid-state lasers.** Hadley, G.R.; Owyoung, A.; Esherick, P.; Hohimer, J. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Applied Optics;* **27**: No. 5, 819-827(1 Mar 1988). Contract AC04-76DP00789.

We present a numerical model for the transient response of a longitudinally pumped miniature solid-state laser. The model is suitable for both regenerative amplifiers and oscillators, provided the latter run in a single mode. The results of our calculations compare well with measurements of the peak output powers and pulse widths for a Nd:YAG rod pumped by a ten-stripe diode laser array. Our model predicts saturation at peak powers of approximately twice the 850 mW reported here due to filling of the lower laser level. To overcome this power limitation due to saturation, we also explore the use of miniature Nd:glass laser amplifiers to boost the single-frequency Nd:YAG pulses to powers exceeding 200 W.

4204 Heat Transfer And Fluid Flow

REFER ALSO TO CITATION(S) 29299, 29721, 29722, 29723, 29724

29348 **(AGARD-AG—302) Techniques of flow visualization.** Merzkirch, W.; Gersten, K. (Advisory Group for Aerospace Research and Development, 92 - Neuilly-sur-Seine (France)). Dec 1987. 100p. NTIS, PC A05/MF A01.

The methods of flow visualization are reviewed with particular emphasis on their application in wind tunnels, water tunnels, and experiments related to propulsion research. The discussion of methods starts with those that visualize the flow pattern on a solid surface. Then methods visualizing the whole field, either by introducing a foreign substance (smoke, dye) or by making use of refractive index changes in the flowing fluid (optical methods) are examined. Emphasis is placed on the discussion of the physical background of a method rather than on technical details.

29349 (DOE/ER/13398—8) Heating and evaporation of turbulent liquid films: Measurement of film thickness and the onset of nucleate boiling:. Mudawwar, I.A.; Tiederman, W.G.; Koskie, J.E.; Marsh, W.J. (Purdue Univ., Lafayette, IN (USA). Heat Transfer Lab.). Mar 1988. Contract FG02-85ER13398. 202p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE88006388/JAW.

The hydrodynamics of liquid films has been a subject of intense interest in the design of process equipment. Many chemical reaction chambers introduce liquid reactants in the form of films on the walls of a vessel. Liquid films are also commonly encountered in heat exchangers. For example, in process condensers, a vapor condeses and forms a liquid film on a solid surface. Great interest has developed in recent years in plate type condensers and evaporators. These heat exchangers consist of a number of parallel vertical plates. The fluid to be heated and the liquid to be cooled flow in the form of liquid films in the spaces between alternating plates. Since the design is simple, these devices are efficient to construct;however, the thermal design of the equipment is still empirical. One special case of liquid films that is commonly encountered in industrial processes is the free-falling film on a vertical surface. This case is of interest not only because it is often used, but also because it is a limiting case of the much broader problem of shear driven film flows. A number of investigations of falling films have been conducted;however no one has been able to model fully the interfacial disturbances. The general purpose of this study is to develop a better understanding of the fluid mechanics of falling liquid films.

29350 (IC—87/100) Nonequilibrium flow of a radiating gas in a vertical channel with axial temperature variation. Bestman, A.R. (International Centre for Theoretical Physics, Trieste (Italy)). May 1987. 15p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702535/JAW.

Buoyancy induced flow of a vibrationally relaxing radiating gas in a vertical channel is studied for the case when one of the channel walls is cold while the other is hot. On the hot wall there is superimposed a small axial linear wall temperature variation. Perturbation expansions are developed for the solution and the basic problem which is nonlinear is integrated in a close form for an optically thin grey gas. The next approximation is linear and so is tackled by a fourth order Runge-Kutta method. Quantitative discussions of the solutions are presented. (author). 6 refs, 2 figs.

29351 (IC—87/101) Nonequilibrium flow of a dissociating gas in a horizontal channel with axial temperature variation. Bestman, A.R. (International Centre for Theoretical Physics, Trieste (Italy)). May 1987. 17p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702536/JAW.

Flow of a rarefied high temperature ideal dissociating gas in a horizontal channel is studied under a general differential approximation for radiative heat flux. On the assumption that there is a small but linear axial wall temperature variation, the problem is tackled by a perturbation series expansion. The basic approximation is nonlinear and it is tackled by an iterative algorithm involving nonlinear integral equations. The higher approximation which is linear is solved by a finite difference scheme. Consequences of the effect of relaxation on the heat transfer are discussed quantitatively. (author). 7 refs, 2 figs.

29352 (IC—87/102) Hydrodynamic stability of a chemically reacting fluid in a porous medium. Bestman, A.R. (International Centre for Theoretical Physics, Trieste (Italy)). May 1987. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702537/JAW.

The onset of instability occasioned by mass concentration gradient in a porous medium is investigated within the realms of hydrodynamic stability. It is established that as the permeability of the medium decreases, the Rayleigh number for onset of instability rises linearly over a wide range of values of permeability. Thus, even though porosity increases stability, the critical Rayleigh number for onset of instability is within accessible range and turbulence could occur in ground fluid hydrology. (author). 3 refs, 1 fig., 1 tab.

29353 (IC—87/103) Radiative heat transfer to chemically reacting flow between concentric rotating spheres. Bestman, A.R. (International Centre for Theoretical Physics, Trieste (Italy)). May 1987. 21p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702538/JAW.

The flow between two hot concentric rotating spheres in the presence of chemical reaction is used to model the depletion of ozone by nitrogen and chlorine compounds in the middle atmosphere. Even the most modest of calculations reveal that a 6% depletion of ozone could very easily be achieved as a result of bush burning or extensive use of fertilization for agricultural purposes. (author). 5 refs, 3 figs.

29354 (LNCC—016/86) Consistent formulation of the finite element method for solving diffusive-convective transport problems. Carmo, E.G.D. do; Galeao, A.C.N.R. (Rio de Janeiro Univ. (Brazil). Coordenacao dos Programas de Pos-graduacao de Engenharia). (Laboratorio Nacional de Computacao Cientifica, Rio de Janeiro (Brazil)). 1986. 36p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702607/JAW.

A new method specially designed to solve highly convective transport problems is proposed. Using a variational approach it is shown that this weighted residual method belongs to a class of Petrov-Galerkin's approximation. Some examples are presented in order to demonstrate the adequacy of this method in predicting internal or external boundary layers.

29355 (LNCC—016/87) Consistent approximate upwind Petrov-Galerkin Method for convection-dominated problems. Galeao, A.C.N.R.; Carmo, E.G.D. do. (Laboratorio Nacional de Computacao Cientifica, Rio de Janeiro (Brazil)). Aug 1987. 23p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702608/JAW.

A systematic procedure to obtain the appropriate upwind direction and associated Petrov-Galerkin weightin function for the advection-diffusion equation is presented. It is shown that sharp internal and boundary layers are accurately approximated with this new method.

29356 (LNCC—017/87) Finite Element Model for convection-dominatel transport problems. Carmo, E.G.D. do; Galeao, A.C.N.R. (Laboratorio Nacional de Computacao Cientifica, Rio de Janeiro (Brazil)). Aug 1987. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702609/JAW.

A new Protev-Galerkin Finite Element Model which automatically incorporates the search for the appropriate upwind direction is presented. It is also shown that modifying the Petrov-Galerkin weightin functions associated with elements adjascent to downwing boudaries effectively eliminates numerical oscillations normally obtained near boundary layers.

29357 (PB—88-858311/XAB) Pipeline-system insulation: thermal insulation and corrosion prevention. January 1976-November 1985 (Citations from the Rubber and Plastics Research Association data base). Report for January 1976-November 1985. (National Technical Information Service, Springfield, VA (USA)). Mar 1988. 170p. NTIS PC N01/MF N01.

This bibliography contains citations concerning thermal and corrosion insulating of pipeline systems used to transfer liquids and gases. Thermal aging of polyurethane foam for insulating heating pipes, extrusion-film pipeline-insulation materials and processes, flexible expanded nitrile-rubber pipeline insulation with class 1 fire rating, and underground fiberglass-reinforced polyester insulated-pipeline systems are among the topics discussed. Applications in solar-heating systems, underground water, oil, and gas, interior hot-water and cold-water lines under seawater, and chemical-plant pipeline-system insulation are included. (This updated bibliography contains 266 citations, none of which are new entries to the previous edition.)

29358 **(PB—88-858329/XAB) Pipeline system insulation: thermal insulation and corrosion prevention. December 1985-February 1988 (citations from the rubber and plastics research association data base). Report for December 1985-February 1988.** (National Technical Information Service, Springfield, VA (USA)). Mar 1988. 77p. NTIS PC N01/MF N01.

Supersedes PB—86-851060.

This bibliography contains citations concerning thermal and corrosion insulating of pipeline systems used to transfer liquids and gases. Thermal aging of polyurethane foam for insulating heating pipes, extrusion-film pipeline-insulation materials and processes, flexible expanded nitrile-rubber pipeline insulation with class 1 fire rating, and underground fiberglass-reinforced polyester insulated-pipeline systems are among the topics discussed. Applications in solar-heating systems, underground water, oil, and gas, interior hot water and cold water lines under seawater, and chemical-plant pipeline-system insulation are included. (This updated bibliography contains 139 citations, all of which are new entries to the previous edition.)

29359 **Comment on Initial stages of pattern formation in Rayleigh-Benard convection.** van Beijeren, H.; Cohen, E.G.D. (Institute for Theoretical Physics, University of Utrecht, Utrecht, The Netherlands). *Physical Review Letters;* **60**: No. 12, 1208-1208(21 Mar 1988).

A Comment on the Letter by C.W. Meyer, G. Ahlers, and D.S. Cannell, Phys. Rev. Lett. 59, 1577 (1987).

29360 **Rectangular heat source on a semi-infinite solid: an analysis for a thin film heat flux gage calibration.** Keltner, N.R.; Bainbridge, B.L.; Beck, J.V. (Thermal Test and Analysis Division, Sandia National Laboratories, Albuquerque, NM 87185). *Journal of Heat Transfer;* **110**: No. 1, 42-48(Feb 1988). Contract AC04-76DP00789.

For a thin film heat flux gage designed to provide both rapid response and long use time, initial calibrations using standard techniques indicated differences between the literature and the estimated properties. In order to estimate thermophysical properties and subsequently the gage sensitivity, an analytical model of the response to a step change in heating current was developed. Starting from a Green's function description, the model is reduced to three algebraic expressions, which correspond to the early, middle, and late time regimes. These expressions provide a framework for least-square estimates of gage parameters. This provides an in situ, nondestructive measurement of the thermal impedance of the substrate. There is very good agreement between the model and the experimental data. The estimated parameter values demonstrated good to excellent repeatability and good agreement with both new literature data and results from destructive property measurements.

29361 **Heat transfer from a flat surface to an oblique impinging jet.** Goldstein, R.J.; Franchett, M.E. (Department of Mechanical Engineering, University of Minnesota, Minneapolis, MN 55455). *Journal of Heat Transfer;* **110**: No. 1, 84-90(Feb 1988).

Experiments are conducted to determine the heat transfer to a jet impinging at different oblique angles to a plane surface. The main portion of the test plate contains a composite sheet of temperature-sensitive liquid crystal, which is sandwiched between a thin metallic-foil heater and a specially designed liquid bath. The results indicate a displacement of the peak heat transfer from the geometric center of the jet origin, the displacement being a function primarily of impingement angle. Contours of constant heat transfer coefficient are obtained and correlated with an empirical equation that permits determination of average Nusselt numbers over areas of interest.

29362 **Mixed convection in a liquid-saturated porous medium.** Reda, D.C. (Sandia National Laboratories, Albuquerque, NM 87185). *Journal of Heat Transfer;* **110**: No. 1, 147-150(Feb 1988). Contract AC04-76DP00789.

An experimental and numerical investigation of mixed convection phenomena about a finite-length, vertical, cylindrical heat source in a unfiorm, liquid-saturated, porous medium was conducted. Bouyancy-induced upflow about the heat source was systematically altered by the superposition of vertical, pressure-driven flows which opposed the bouyancy-induced fluid motion. The evolution of the mixed convection velocity and thermal fields with increasing magnitude of the imposed-flow Peclet number are reported. The ratio of the natural convection Rayleigh number Ra to the imposed-flow Peclet Number Pa is shown to be the nondimensional parameter that characterizes the relative influence of buoyancy-induced to pressure-driven fluid motion. Using total disappearance of buoyancy-induced upflow as the criterion, the transition from mixed to forced convection, for opposing flows, is numerically predicted to occur for {vert←bar} Ra/Pe {vert←bar}≅1/2, independent of the heat source length or power input.

29363 **Radiation shape factors for channels with varying cross sections.** Eddy, T.L.; Nielsson, G.E. (School of Mechanical Engineering, Georgia Institue of Technology, Atlanta, GA 30332). *Journal of Heat Transfer;* **110**: No. 1, 264-266(Feb 1988).

Calculations are performed on radiant heat transfer in irregularly shaped chambers with allowance for blocking by the horizon. (AIP)

29364 **Pool boiling enhancement of a modified GEWA-T surface in water.** Ayub, Z.H.; Bergles, A.E. (E.L. Nickell Co., Inc., Constantine, MI 49042). *Journal of Heat Transfer;* **110**: No. 1, 266-268(Feb 1988).

Substantial nucleate boiling enhancement was observed for a GEWA-T section filled with an ordinary sponge. (AIP)

29365 **Effect of channel curvature on phase distribution for air and water two-phase flow.** Lin, W.K. College Park, MD; Univ. of Maryland (1986). 251p. University Microfilms Order No. 87-09,435.

Thesis (Ph. D.).

Two-phase (air/water) measurements of the phase-distribution phenomena were made in a transparent model of a PWR hot leg by measuring pressure differential and conductivity at room temperature. These measurements were performed in a series of tests investigating two-phase-flow characterization. Test conditions were selected to cover a range of gas and liquid superficial velocities expected to occur in a prototypical reactor geometry during a small-break loss-of-coolant accident. For comparison, tests at high gas superficial velocities were also performed in which the void fraction was obtained with three differential pressure units. Results include average void fraction, local pressure profile, local velocity profile, and the local void-fraction profile. Results are found to be in generally good agreement with the drift-flux model for vertical pipes. A Weir Model was developed to relate the liquid flow rate with the level of water in the Omega-bend. To test this model, data were taken from three different test loops. Results appear to agree with the theoretical calculation as long as it is in the single liquid phase or the bubbly flow regime. This study also presents a new technique to estimate the local average void fraction and the liquid mean superficial velocity profile by using the conductivity probe in conjunction with a pitot tube.

4205 Materials Testing

REFER ALSO TO CITATION(S) 28976, 28977, 29223

29366 **(CONF-880841—2) SHaRE: Collaborative materials science research.** Kenik, E.A.; More, K.L. (Oak Ridge National Lab., TN (USA); Oak Ridge Associated Universities, Inc., TN (USA)). 1988. Contract AC05-84OR21400. 3p.

From MAS/EMSA microbeam analysis conference; Milwaukee, WI, USA (7 Aug 1988).

The Shared Research Equipment (SHaRE) Program provides access to the wide range of advanced equipment and techniques available in the Metals and Ceramics Division of ORNL to researchers from universities, industry, and other national laboratories. All SHaRE projects are collaborative in nature and address materials science problems in areas of mutual interest to the internal and external collaborators. While all facilities in the Metals and Ceramics Division are available under SHaRE, there is a strong emphasis on analytical electron microscopy (AEM), based on state-of-

the-art facilities, techniques, and recognized expertise in the Division. The microscopy facilities include four analytical electron microscopes (one 300 kV, one 200 kV, and two 120 kV instruments), a conventional transmission electron microscope with a low field polepiece for examination of ferromagnetic materials, a high voltage (1 MV) electron microscope with a number of in situ capabilities, and a variety of EM support facilities. An atom probe field ion microscope provides microstructural and elemental characterization at atomic resolution. Other facilities utilized under SHaRE include several Auger electron spectroscopy/surface analytical instruments, a triple beam Van de Graaff accelerator facility for nuclear microanalysis techniques, various x-ray diffraction instruments, a Nanoindenter for high spatial resolution mechanical property measurements, and a host of other advanced and unique facilities.

4208 Electronic Circuits And Devices

REFER ALSO TO CITATION(S) 28984, 29256, 29344, 29564

29367 **(SAND—87-7172C) A monolithic reduced-size Ku-band SPDT [single-pole double-throw] FET switch.** Bryant, D.T. (Texas Instruments, Inc., Dallas (USA)). [1988]. Contract AC04-76DP00789. 17p. (CONF-880565—2). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88006273/JAW.

From IEEE MTT-S international microwave symposium; New York, NY, USA (25 May 1988).

A GaAs ku-band monolithic single-pole double-throw (SPDT) FET switch has been designed and demonstrated. Small-signal insertion loss is less than 1.4 dB over a 14 GHz to 18 GHz band with a VSWR less than 1.5:1. The common terminal to off-channel isolation exceeds 18 dB. The switching is achieved with a -4.5 volt signal on the gate of the on-channel FET with the other gate at 0 volts. The switching current requirement is only the reverse bias gate leakage current (typically 3 uA). Large-signal performance is similar with a -10 volt control signal. The small chip size, 1.3 mm x 1.3 mm x 0.15 mm, permits more than 2300 monolithic switches to be fabricated on a single 3-inch GaAs wafer. 9 figs.

4210 Combustion Systems

REFER ALSO TO CITATION(S) 28863, 28864, 28865, 28872, 28873, 29250

29368 **(AGARD-CP—421) Advanced technology for aero gas turbine components.** (Advisory Group for Aerospace Research and Development, 92 - Neuilly-sur-Seine (France)). Sep 1987. 541p. (In several languages). (CONF-8705286—). NTIS, PC A23/MF A01.

From Advanced technology for aero gas turbine components; Paris, France (4 May 1987).

The Symposium is aimed at highlighting the development of advanced components for new aero gas turbine propulsion systems in order to provide engineers and scientists with a forum to discuss recent progress in these technologies and to identify requirements for future research. Axial flow compressors, the operation of gas turbine engines in dust laden atmospheres, turbine engine design, blade cooling, unsteady gas flow through the stator and rotor of a turbomachine, gear systems for advanced turboprops, transonic blade design and the development of a plenum chamber burner system for an advanced VTOL engine are among the topics discussed.

29369 **(N—88-17561) Overview of heat transfer and fluid flow problem areas encountered in stirling engine modeling.** Tew, R.C. Jr. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Feb 1988. 23p. (NASA-TM—100131; E—3680; NAS—1.15:100131; CONF-871234—). NTIS, PC A03/MF A01.

From ASME winter meeting; Boston, MA, USA (13 Dec 1987).

NASA Lewis Research Center has been managing Stirling engine development programs for over a decade. In addition to contractual programs, this work has included in-house engine testing and development of engine computer models. Attempts to validate Stirling engine computer models with test data have demonstrated that engine thermodynamic losses need better characterization. Various Stirling engine thermodynamic losses and efforts that are underway to characterize these losses are discussed.

29370 **(N—88-18007) Ceramic bearings for use in gas turbine engines.** Zaretsky, E.V. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1988. 15p. (NASA-TM—100288; E—3934; NAS—1.15:100288; CONF-880607—). NTIS, PC A03/MF A01.

From 33. international gas turbine conference and exhibit; Amsterdam, Netherlands (5 Jun 1988).

Three decades of research by U.S. industry and government laboratories have produced a vast body of data related to the use of ceramic rolling element bearings and bearing components for aircraft gas turbine engines. Materials such as alumina, silicon carbide, titanium carbide, silicon nitride, and a crystallized glass ceramic have been investigated. Rolling-element endurance tests and analysis of full-complement bearings have been performed. Materials and bearing design methods have continuously improved over the years. This paper reviews a wide range of data and analyses with emphasis on how early NASA contributions as well as more recent data can enable the engineer or metallurgist to determine just where ceramic bearings are most applicable for gas turbines.

4240 Pollution Control Equipment

REFER ALSO TO CITATION(S) 28923

43 PARTICLE ACCELERATORS

REFER ALSO TO CITATION(S) 29629

4301 Design, Development, And Operation

29371 **(ANL/APS-CP—1) Proceedings of the first users meeting for the Advanced Photon Source.** (Radiation Monitoring Devices/DEVCOM, Watertown, MA (USA)). Feb 1988. Contract W-31109-ENG-38. 175p. (CONF-8611228—).

From 1. users meeting for the advanced photon source; Argonne, IL, USA (13 Nov 1986).

The first national users meeting for the Advanced Photon Source (APS) at Argonne National Laboratory - held November 13-14, 1986, at Argonne - brought together scientists and engineers from industry, universities, and national laboratories to exchange information on the design of the facility and expectations for its use. Presented papers and potential participating research team (PRT) plans are documented in these proceedings. Topics covered include the current status of the project, an overview of the APS conceptual design, scientific opportunities offered by the facility for synchrotron-radiation-related research, current proposals and funding mechanisms for beam lines, and user policies. A number of participants representing universities and private industry discussed plans for the possible formation of PRTs to build and use beam lines at the APS site. The meeting also provided an opportunity for potential users to organize their efforts to support and guide the facility's development.

29372 **(BNL—40872) The relativistic heavy ion collider project: An overview.** Ludlam, T.W.; Samios, N.P. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 15p. (CONF-870543—9).

From 2. workshop on experiments and detectors for relativistic heavy ion collider; Berkeley, CA, USA (25 May 1987).

We have now seen the first results from experiments with high energy nuclear beams at Brookhaven and CERN. These experiments, which began about a year ago, use fixed targets at the AGS and SPS. These programs have begun with relatively light ions ($A \leq 32$ amu) to explore states of compressed nuclear matter in which high energy density is achieved in an environment of high baryon density at energies near the maximum for nuclear stopping.

The widespread interest and excitement which these experiments have generated is due in large part to the fact that they are providing the first glimpse of what is expected to be an entire new regime of physical phenomena, and that these experiments will be followed in the near future by measurements with much higher beam masses and much higher collision energies. This is the mission of the Relativistic Heavy Ion Collider (RHIC) project now being prepared for construction at Brookhaven. The status of the RHIC project is discussed, including accelerator design, experiments and detectors.

29373 **(PB—88-165089/XAB) Basic characteristics of a rail accelerator with inductive energy storage and pulse formation.** Daree, K. (Institut Franco-Allemand de Recherches de Saint-Louis, 68 (France)). 17 Dec 1986. 60p. (In German). (ISL-N—610/86). NTIS, PC E04/MF E04.

A system combined of energy supply, energy storage, pulse formation, and rail accelerator (railgun) is investigated. Typical values for maximal current (200 kA to 1 MA), rail length (one to several meters), the attainable projectile speed (3 to 10 km/s), the electrical efficiency (1 to 10%) and the overall efficiency (< 1 to 3%) are derived and possible improvements are discussed. For current supply, basically much higher requirements with respect to ohmic losses occur with homopolar generators than with condenser batteries. Generally, the losses in the current supply circuit increase in proportion to the capacity of the current source, while the electrical efficiency of the railgun increases.

29374 **Cryogenic experiments on rf accelerating structures.** Fortgang, C.M.; Bolme, G.O.; Lamoureux, J.; Liska, D.J. (Los Alamos National Lab., NM (USA)). *Nuclear Instruments and Methods in Physics Research;* **262**: No. 2/3, 197-199(15 Dec 1987).

The advantages of operating a drift-tube linear accelerator at cryogenic temperature motivated a series of experiments that investigated quality (Q) factor enhancement of cryogenic radio-frequency (rf) accelerating structures. The experiments were performed at both low and high rf power over a temperature range of 4-293 K.

29375 **LYRAN: A program for the analysis of linac beam dynamics.** Lu, J.Q.; Ben-Zvi, I.; Cramer, J.G. (Washington Univ., Seattle (USA). Nuclear Physics Lab.). *Nuclear Instruments and Methods in Physics Research;* **262**: No. 2/3, 200-206(15 Dec 1987).

The FORTRAN program LYRAN has been written for use in analyzing the beam dynamics of superconducting heavy ion linacs. The program is based on the program LYRA developed by A.H. Scholldorf at SUNY Stony Brook, but that original program has been extensively extended, modified, and restructured. LYRAN transports a group of input particles randomly distributed on a selected distribution function through linac elements which include rf accelerating and bunching elements, dipole and quadrupole magnets, electrostatic elements, and drift spaces. Second order corrections to dipole and quadrupole fields are included. A nonlinear optimization routine is incorporated, providing fast and efficient determination of accelerator configurations and parameter settings that provide desired beam properties. Beam envelope plotting is also included to provide a graphic display of beam characteristics.

4302 Beam Dynamics, Field Calculations, And Ion Optics

REFER ALSO TO CITATION(S) 29375, 29604

29376 **(BNL—40856) Plasma neutralizer work at BNL [Brookhaven National Laboratory].** Hershcovitch, A.; Kovarik, V.; Prelec, K. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 6p. (CONF-880256—2). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88007046/JAW.

From 3. European workshop production and applications of light negative ions; Amersfoort, Netherlands (17 Feb 1988).

Conversion of high energy light negative ions into neutrals due to collisions with plasma electrons and ions can be very efficient (85{percent} for H/sup {minus/}D/sup {minus/} and > 60{percent} for Li/sup {minus/}). For negative ions above 1 MeV, the presence of gases and ions heavier than protons in a neutralizer dramatically reduces neutralization efficiencies, especially those of heavier negative ions (e.g., Li/sup {minus/}, C/sup {minus/}, Si/sup {minus/}). Consequently, our neutralizer studies were focused on generation of hydrogen plasma targets. As a plasma source, the hollow cathode discharge (HCD) proved to be optimal due to its flexibility and steady-state generation of a high density, highly ionized plasma. Plasma targets in a number of configurations were generated with a power consumption well over an order of magnitude lower than other plasma targets. A full-scale plasma neutralizer was successfully built and deployed in a beam line of the BNL Tandem Van de Graaff to neutralize multi-MeV beams of Li/sup {minus/}, C/sup {minus/}, and Si/sup {minus/}. Another plasma neutralizer was designed for the 1-2 A, 160 keV steady state D/sup {minus/} LBL (National Plan) beam line. Preliminary experiments to generate field-free plasma targets were performed. Studies were done with three confinement configurations: multi-cusp, double helix, and quartz tube. In the multi-cusp and double helix cases, confinement is provided by a magnetic field which is large at the plasma boundary with vanishing strength in the target itself. The third scheme utilized a quartz tube, i.e., the confinement is electrostatic by a charged insulator, with electrostatic field vanishing in a few Debye lengths. 11 refs., 2 figs., 2 tabs.

29377 **(BNL—40929) On bunch lengthening using the fourth harmonic cavity in the NSLS VUV ring.** Wachtel, J.M. (Brookhaven National Lab., Upton, NY (USA)). Feb 1988. Contract AC02-76CH00016. 21p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88007392/JAW.

It has been suggested that the phase of the beam excited voltage in the harmonic cavity can be controlled by detuning its resonant frequency from the beam current harmonic. Unfortunately the detuning needed to flatten the acceleration waveform also corresponds to the region of Robinson instability for the harmonic cavity. Therefore, lengthening the bunch may be followed by large amplitude synchrotron oscillation of the bunch center of mass. Bunch lengthening is discussed in this note from several points of view. There follows a simple review of single electron oscillations in a quartic potential. Then equations are developed for the coupled oscillations of a cavity and a rigid bunch as a fully nonlinear, time dependent initial value problem. Next, a computer program that solves these equations for one, two or more cavities, with and without externally driven fields, is described and some simulations of the harmonic cavity interaction are shown. Finally, the fully nonlinear equations are linearized to derive a dispersion relation for the case of beam excitation in the harmonic cavity. 6 refs., 5 figs.

29378 **(FNAL-TM—1515) Exact solution of the Derbenev-Kondratenko n axis for a model with one resonance.** Mane, S.R. (Fermi National Accelerator Lab., Batavia, IL (USA)). Mar 1988. Contract AC02-76CH03000. 4p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88007432/JAW.

This paper discusses the solution of the hamiltonian of a particle circulating in a storage ring which have quantized spin axis eigenstates that commute with the hamiltonian. 3 refs. (LSP)

4303 Auxiliaries And Components

REFER ALSO TO CITATION(S) 29784, 29802

29379 **(BNL—40822) PHOTON: A user's manual.** Chapman, D. (Brookhaven National Lab., Upton, NY (USA)). Jan 1988. Contract AC02-76CH00016. 53p. NTIS, PC A04; GPO Dep. Order Number DE88007569/JAW.

PHOTON has proven very useful in the development of the X17 superconducting wiggler beamline. Its use has determined the shielding required from the wiggler device to the very end of the beamline in the hutches and angiography section. Doses calculated by this program have been compared with experimental results from conventional bending magnet beamline with great success. In each case the program consistently overestimated the dose by factors ranging from 2 to 10. The reason for this overestimation is understood and was not refined further in the program in order to maintain some level of safety in the shielding calculations.

PHOTON should prove useful in the design of any beamline. Its ability to calculate power deposited and spectra transmitted through nearly arbitrary beamline configurations as well as the scattered radiation doses through shielding walls make it a very powerful tool.

29380 **(CONF-8709217—4) Tutorial on computer control.** Juras, R.C. (Oak Ridge National Lab., TN (USA)). Sep 1987. Contract AC05-84OR21400. 25p.

From SNEAP conference; Tallahassee, FL, USA (27 Sep 1987).

This paper discusses computer architecture modfications and development used to control particle accelerators. 6 refs., 3 figs.

29381 **Remote operations and viewing using the monitor system.** Grisham, D.L.; Lambert, J.E.; Baldwin, T.S.; Ekberg, E.L.; Hernandez, T.R.; Raybun, J.L. pp 39-43 of Proceedings 32nd conference on remote systems technology. Volume 2. Los Alamos, NM; Los Alamos national Laboratory (1984).

Over the past two years, major rebuilding operations were conducted at the Clinton P. Anderson Meson Physics Facility (LAMPF). These operations involved replacement of complex experimental apparatus in high-radiation areas using servomanipulators and video viewing. All remote tasks were completed on or ahead of allotted schedules. This success is attributed to continuing improvement of manipulators, viewing systems, and operating techniques. 2 references, 6 figures.

4304 Storage Rings

REFER ALSO TO CITATION(S) 29378

44 INSTRUMENTATION

4401 Radiation Instrumentation

REFER ALSO TO CITATION(S) 29372, 29499, 29629, 29702

29382 **(CBPF-NF—024/87) Detection of fission fragments using thick samples in contact with solid state nuclear track detectors.** Lima, D.A. de; Martins, J.B.; Tavares, O.A.P. (Paraiba Univ., Joao Pessoa (Brazil). Dept. de Fisica). (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. 25p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702491/JAW.

Whenever use is made of thick samples in contact with solid state nuclear track detectors for determining fission yields, one of the fundamental problems is the evaluation of the effective number of target nuclei which contributes to the fraction of the number of fission events that will be recorded. The evaluation of the effective number of target nuclei which contributes to recorded events is based on the effective thickness of the sample. A method for evaluating effective thickness of thick samples for binary fission modes, is presented. A cross section equation which takes into account all the necessary corrections due to fragment attenuation effects by a thick target for calculation induced fission yields, was obtained.

29383 **(CERN-EP—86-204) Test of a BaF_2-TMAE [tetrakis(dimethylamine)ethylene] detector for positron-emission tomography.** Mine, P.; Santiard, J.C.; Scigocki, D.; Charpak, G.; Suffert, M. (European Organization for Nuclear Research, Geneva (Switzerland); Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). 2 Dec 1986. 4p. (CONF-861007—31).

From Nuclear science and nuclear power systems symposium; Washington, DC, USA (29 Oct 1986).

A solid-state proportional counter, consisting of the BaF_2-TMAE combination, has been tested for the detection of 511 keV annihilation gamma-rays in a PET system. Energy, time, and position resolutions are given for 1 cm wide BaF_2 crystals, using different temperatures and gases at low pressures. 10 refs., 9 figs.

29384 **(DOE/ER/40368—1) Studies of high energy phenomena using muons:.** Hedin, D.; Kaplan, D. (Northern Illinois Univ., Dekalb (USA). Dept. of Physics). 1988. Contract AC02-87ER40368. 11p.

This paper discusses the use of muons for detection systems in high energy physics experiments. Discussed are DO detectors, muon data acquisition and electronics, muon software, heavy quark physics, chamber fabrication and superconductor super collider related work. 11 refs. (LSP)

29385 (DOE/ER/60402—1, pp 44) **Development of the secondary emission scintillation counter for microdosimetry in the nanometer region.** Goldhagen, P. Jul 1986. NTIS, PC A05/MF A01. Order Number DE86013991/JAW.

In Radiation physics, biophysics, and radiation biology. Progress report, December 1, 1985-November 30, 1986.

This year, work has been resumed on a device, originally called an avalanche chamber, with which the authors hope to count ionizations of particle tracks in gas volumes simulating sites with diameters of the order of one nanometer. The device works by drifting ions from the track to a small region of high electric field where they are accelerated onto a dynode, producing secondary electrons. The secondary electrons are then accelerated onto a scintillator, and the resulting light is detected by a photomultiplier.

29386 (DOE/ER/75172—5, pp 39-47) **Angular dependency and time/temperature dependent fade in panasonic TLDs.** Cottle, C.L. (Arizona State Univ., Tempe (USA)). 1987. NTIS, PC A06/MF A01. Order Number DE88005041/JAW. (CONF-8703231—Summs.).

From Western region American Nuclear Society student conference: nuclear technology for the year 2000; Albuquerque, NM, USA (19 Mar 1987).

Thermoluminescent dosimetry is a rapidly growing form of personnel dosimetry. Studies of the factors affecting TLD readings are of particular significance for safety and future TLD design. Two commonplace environmental problems were studied to determine their relationship to TLD readings. The longterm fade due to high (120°F) temperature was the first study. The second study examines the relationship between exposure reading and the angle of incident radiation on the Panasonic TLD badge. Differences between the four elements of the TLD badge were contributed to the thermoluminescent material involved (calcium or lithium compounds). The temperature fade study revealed a linear fade for the calcium material and an exponential fade for the lithium material. A definite angular dependence for exposure readings was also established.

29387 (DOE/ER/75172—5, pp 48-52) **Comparative study of three types of high-range civil defense pocket dosimeters.** Siskel, R.L.; Sims, S.; Swaja, R. (Texas A & M Univ., College Station (USA)). 1987. NTIS, PC A06/MF A01. Order Number DE88005041/JAW. (CONF-8703231—Summs.).

From Western region American Nuclear Society student conference: nuclear technology for the year 2000; Albuquerque, NM, USA (19 Mar 1987).

Civil Defense shelters are supplied with high-range (0 to 200 Roentgen) CDV-742 pocket dosimeters for use by people who might be exposed to significant levels of radiation. It is important that the dosimeters are accurately characterized. The Federal Emergency Management Agency is particularly interested in the dosimeter response to mixed gamma and neutron fields. A total of 67 dosimeters were therefore obtained for study at Oak Ridge National Laboratory's Health Physics Research Reactor (HPRR). Twenty-seven Bendix, twenty Landsverk-gold, and twenty of the Landsverk-yellow dosimeters were evaluated, with and without phantoms, for precision, overall accuracy, neutron and spectral responses, and failure rates. Finally a comparison was made between the three dosimeter types. Good precision, averaging +/- 9.6%, was obtained within any group of exposed dosimeters. In mixed gamma and neutron fields, the dosimeters indicated exposures greater than the gamma component alone. The accuracy when compared to the total reference dose, however, was spectra dependent and quite poor overall. The dosimeters at air stations indicated approximately 16% of the reference dose when in a hard

spectrum (13 cm steel shield). In intermediate spectra (unshielded and 20 cm concrete shield), approximately 17% to 65% was recorded. In a very soft spectrum (12 cm lucite shield), approximately 81% of the reference dose was indicated. In all cases, dosimeters set up on phantoms showed exposures approximately 1.3 times greater than those on ring stands. The operating voltage range was determined to have no effect on individual dosimeters response in the Bendix and Landsverk-Yellow types. The Bendix dosimeters had a 37% failure rate, and the Landsverk-Yellow a 55% rate. The Landsverk-Gold, with a 5% failure rate, were much more reliable.

29388 (DOE/ER/75172—5, pp 53-57) **Effect of surface contaminants on the light emission spectrum of LiF TLDs.** Abhold, M.E. (Univ. of Washington, Seattle (USA)). 1987. NTIS, PC A06/MF A01. Order Number DE88005041/JAW. (CONF-8703231—Summs.).

From Western region American Nuclear Society student conference: nuclear technology for the year 2000; Albuquerque, NM, USA (19 Mar 1987).

Recent results show the differences between the light emissions spectra from LiF Thermoluminescent Dosimeters (TLDs) for gamma vs. alpha irradiations to be due to contaminants on the surface of the TLD. The light emission spectrum for thermal neutron irradiations was observed to be identical to that for a Cs-137 gamma irradiation in Harshaw TLD-100. Further experiments with surface treatments on TLD-100 indicate trace contaminants introduced by the standard methanol cleansing rinse in reagent grade methanol to have a substantial effect on the light emission spectrum for Am-241 alpha irradiations.

29389 (DOE/ER/75172—5, pp 79-95) **Background radiation shielding for radiation detectors.** Derks, W. (Arizona State Univ., Tempe (USA)). 1987. NTIS, PC A06/MF A01. Order Number DE88005041/JAW. (CONF-8703231—Summs.).

From Western region American Nuclear Society student conference: nuclear technology for the year 2000; Albuquerque, NM, USA (19 Mar 1987).

A Silicon Lithium radiation detector is used to measure radioactivity (count rate) for low energy radioactive gamma ray emitters. The shield must be designed to provide better background radiation shielding with less backscatter. This shield attenuates background by more than a ratio of 1:34. Shield design and construction is examined. Also, the theory of photon interaction and radiation attenuation for low energy photons is described in detail. In addition, there is an explanation of the photoelectric effect. The appendix provides a sketchy example of the stress analysis needed for this 675 lb shields.

29390 (FNAL-TM—1512) **The response of a Fermilab-designed ion chamber in pulsed photon fields.** Freeman, W.S.; Hartman, B.; Krueger, F.; Larson, J. (Fermi National Accelerator Lab., Batavia, IL (USA)). 26 Jan 1988. Contract AC02-76CH03000. 20p.

This note reports measurements of the response of a Fermilab-designed area monitor ionization chamber used in Chipmunk and Scarecrow detectors to pulsed photon fields of various intensities and durations. The measurements were made to better define the operating limits of the instruments and to understand the possible effects of recombination and space charge on the dose measured by the instruments in pulsed fields. 2 refs., 13 figs., 1 tab.

29391 (MPD/NBS—339) **Users guide to the inelastic rotor spectrometer (IRS).** Bunce, L.J. (comp.). (UKAEA Harwell Lab. Materials Physics and Metallurgy Div.). Nov 1987. 34p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753405/JAW.

The paper is a users guide to the inelastic rotor spectrometer installed on the Harwell 136 Mev electron linear accelerator HELIOS. The spectrometer is designed to measure neutron inelastic scattering for energy transfers from 50 meV to 400 meV and covering a range of Q values from 1 to 15 A^{o-1}. The guide contains a description of:- time-of-flight scales, run and sample changer control units, sample environment, detectors, rotor system, 600 Hz operation of rotor, a run, and data processing. (U.K.).

29392 **Low-pressure ultraviolet photon detector with TMAE gas photocathode.** Majewski, S.; Anderson, D.F.; Constanta-Fanourakis, P.; Kross, B.; Fanourakis, G. (Fermi National Accelerator Lab., Batavia, IL (USA); Rochester Univ., NY (USA)). *Nuclear Instruments and Methods in Physics Research;* **264**: No. 2/3, 235-250(15 Feb 1988).

Results of the study of the properties of a low pressure multistep avalanche counter with TMAE (tetrakis(dimethylamine)ethylene) as the photosensitive gas are presented. The optimization of parameters is discussed. Absolute gas amplification, drift velocity and diffusion of drifting photoelectrons in a low pressure gas and the efficiency of single photoelectron detection are measured. The practical multihit capability and spatial resolution are explored in view of possible application in a Cherenkov ring imaging with multipad wedge-and-strip cathode readout with flash ADCs. The present limit in spatial resolution is due to diffusion of drifting electrons in a low-pressure gas. For applications where photons are detected in a high-rate background of charged particles, the low-pressure operation has many advantages over the atmospheric pressure detectors.

29393 **Design and performance of modularized NaI(Tl) detectors with rectangular crystal elements: An array of 49 and the Crystal Box.** Wilson, S.L.; Hofstadter, R.; Hughes, E.B.; Lin, Y.C.; Parks, R.; Rolfe, J.; Ritter, M.W.; Bolton, R.D.; Bowman, J.D.; Cooper, M.D. (Stanford Univ., CA (USA). W.W. Hansen Labs. of Physics; Stanford Univ., CA (USA). Dept. of Physics; Los Alamos National Lab., NM (USA); Stanford Univ., CA (USA). W.W. Hansen Labs. of Physics; Stanford Univ., CA (USA). Dept. of Physics; Stanford Univ., CA (USA). W.W. Hansen Labs. of Physics; Stanford Univ., CA (USA). Dept. of Physics; Lockheed Missiles and Space Co., Palo Alto, CA (USA)). *Nuclear Instruments and Methods in Physics Research;* **264**: No. 2/3, 263-284(15 Feb 1988).

An array of 49 NaI(Tl) modules each 20 inch in depth and 2.5 inch x 2.5 inch in cross section has been constructed and its properties, especially energy resolution, explored for positrons in the range 20 MeV - 18 GeV. A subsequent much larger detector, the Crystal Box, has also been constructed from 396 modules of the same cross section, but mostly 12 inch in depth, and operated as a γ-ray and positron detector in a search for rare muon decays. The calibration procedure used for the Crystal Box and its characteristic resolutions in energy, impact point and time are described.

29394 **Fast pulse-shaping amplifier.** MacArthur, D.W.; Morgado, R.E. (Los Alamos National Lab., NM (USA)). *Nuclear Instruments and Methods in Physics Research;* **262**: No. 2/3, 378-384(15 Dec 1987).

We describe a fast pulse-shaping amplifier that accepts detector signals with a fast (<50 ns) rise time and a slow (>100 ns) fall time and generates fast output signals with rise and fall times dependent only on the original rise time. Shaping is accomplished by subtracting an attenuated and delayed version of the input signal from the input signal itself. This circuit is ideal for operation in dead-time-limited situations although some energy information is necessarily lost. The shaping circuit is simple enough to be easily used with many types of detectors.

29395 **Charge measurements of stopping high-Z nuclei ($6 \leq Z \leq 92$) in nuclear emulsion.** Ghoniem, M.T.; Heckman, H.H.; Karant, Y.J. (Lawrence Berkeley Lab., CA (USA)). *Nuclear Tracks and Radiation Measurements;* **13**: No. 2-3, 99-103(1987).

The technique of charge determination by measurements of track-width of stopping tracks in nuclear emulsion has been extended to uranium nuclei. The method utilizes the last 1 mm of residual range to estimate mean-track-widths, and has been applied to nuclear beams of $Z = 6$, 26, 57 and 92. A resolution in charge of $\Sigma(Z) \leq 2$ units was obtained over the entire interval of charges $6 \leq Z \leq 92$.

29396 Evaluation of NTA film in an accelerator environment and comparisons with CR-39. Greenhouse, N.A.; Castro, T.M. de; McCaslin, J.B.; Smith, A.R.; Sun, R.K.; Hankins, D.E. (Lawrence Berkeley Lab., CA (USA);Lawrence Livermore National Lab., CA (USA)). *Radiation Protection Dosimetry;* **20**: No. 3, 143-147(1987). Contract W-7405-ENG-48;AC03-76SF00098.

The Lawrence Berkeley Laboratory (LBL) has enjoyed decades of successful experience with NTA film because of the relatively energetic neutron spectra in the workplace and a cool, low humidity environment. The recognised existence of softer neutron spectra at some locations at LBL, and the availability of CR-39 as a possible alternative dosemeter prompted this study to determine neutron dosemeter adequacy in these areas. CR-39 offers several advantages over NTA film, including lack of latent track fading, the potential for automated readout, and improved response to lower energy neutrons. The CR-39 detection threshold of 0.1 MeV or less made it a particularly attractive possible alternative for neutron dosimetry at LBL's lower energy accelerators. A dosimetry study was conducted at one location at the SuperHILAC where the average neutron energy was about 0.5 MeV and the maximum was about 20 MeV. Neutron fluence, energy spectrum and dose equivalent measurements were made with a variety of active instruments at this accelerator during exposure of a rotating phantom, upon which NTA film and CR-39 dosemeters were attached. The results indicated that with standard calibration techniques both dosemeter types responded adequately to at least half of the total measured dose equivalent.

29397 Preirradiation sensitivity loss of reader-annealed LiF TLDs. Poeton, R.W.; Stanford, N.; Scannel, M.J. *Transactions of the American Nuclear Society;* **54**: 185(1987). (CONF-870837—).

From 13. American Nuclear Society international meeting on nuclear power plant operation; Chicago, IL, USA (30 Aug 1987).

Yankee Atomic Electric Company (YAEC) maintains a thermoluminescent dosimeter (TLD) dosimetry service using a Harshaw TLD badge system consisting of two TLD cards in a plastic case and automatic 2271 readers. Beginning in 1986, a standardized on-site quality assurance testing program was instituted for the facilities provided with YAEC personnel dosimetry. Results obtained during the first half of 1986 indicated a low bias in test TLD results on the order of 10 to 15%. A subsequent investigation attributed this bias to a previously unidentified loss in the sensitivity of reader-annealed LiF TLDs with storage time prior to irradiation. The discovery of this effect, based on in-plant quality assurance testing, demonstrates the usefulness of even relatively simple quality assurance tests by users themselves, regardless of the apparent thoroughness of other testing.

29398 Development of a technique and conceptual design of a survey instrument for beta dosimetry in the nuclear power industry. Murphy, R.O. Atlanta, GA; Georgia Institute of Technology (1986). 198p. University Microfilms Order No. 87-07,858.

Thesis (Ph. D.).

Before an employee of the nuclear power industry can be assigned to work in an area with radiation hazards, the total dose rate from all radiation present should be known to determine the risk. As the plants age, the level of maintenance has increased and certain tasks have required the workers to be exposed to intense beta radiation fields. Currently available survey instruments do not accurately assess the beta dose or dose rate in many circumstances due to several factors, including the fluctuation of the response of the detector due to the variation in the energy of the beta particles comprising the radiation field. This research involved developing a technique for calculating the beta dose rate, using the differential energy spectrum and the fluence rate for the beta particles, the fundamental features of the beta radiation. The energy spectrum was used to determine a spectrum weighted average mass stopping power (SWAMPS). The SWAMPS, when multiplied by the fluence rate, gives the energy deposited per unit mass per second, which is the absorbed dose rate for the beta radiation. Reference sources were developed and calibrated using an extrapolation chamber that had, itself, been calibrated using beta sources at the National Bureau of Standards. Different spectrometry systems were tested for applicability to the SWAMPS technique.

4403 Miscellaneous Instruments

REFER ALSO TO CITATION(S) 29163, 29366, 29579, 29796, 29797, 29798, 29799, 29803

29399 (DOE/ER—0343, pp 65-68) Optical chemical sensors for environmental monitoring. Angel, S.M.; Daley, P.F.; Kulp, T.J. 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.).

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

The development of an optical chemical sensor, or optrode, is reported. The portable instrument is a sensitive and specific detector capable of analyzing chlorinated organic chemicals in ground water at levels of less than 100 ppb. Efforts are underway to develop enzyme-based optrodes using immobilized enzymes that will monitor concentrations by measuring the rate of formation of specific products enzymatically catalyzed. Future plans also include development of sensors based on antigen-antibody reactions.

29400 (DOE/ER/75172—5, pp 72-78) Scanning optical densitometer. Frantz, P.J. (Arizona State Univ., Tempe (USA)). 1987. NTIS, PC A06/MF A01. Order Number DE88005041/JAW. (CONF-8703231—Summs.).

From Western region American Nuclear Society student conference: nuclear technology for the year 2000; Albuquerque, NM, USA (19 Mar 1987).

In radiology, it is necessary to analyze X-ray film for film density. This information can be used for analysis of bone density, tumor detection, or even to check for X-ray source uniformity. A scanning optical densitometer is a device that scans X-ray film for film density. In addition, the scanner relays the variable density to a host computer. A device of this type was designed and several prototypes are being built and tested. This device requires unique software which will receive the information from the scanning optical densitometer and provide meaningful displays and analysis for the user. The software will provide a full color display of the X-ray image with four user-specified density levels.

29401 (LA-UR—88-599) Remote temperature-measurement instrumentation for a heated rotating turbine disk. Lutz, S.S.; Turley, W.D.; Borella, H.M.; Noel, B.W.; Cates, M.R.; Probert, M.R. (EG and G Energy Measurements, Inc., Goleta, CA (USA); Los Alamos National Lab., NM (USA); Oak Ridge Gaseous Diffusion Plant, TN (USA); Delco Electronics Corp., Goleta, CA (USA)). 1988. Contract W-7405-ENG-36. 20p. (CONF-880548—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006456/JAW.

From 34. international instrumentation symposium; Albuquerque, NM, USA (1 May 1988).

Thermographic-phosphor (TP) remote temperature sensors were installed on a turbine disk and subjected to thermal and centrifugal stresses in a spin-pit test. The sensors were placed at three different radii on the disk, which was run at 6600, 9330, 11400, and 13200 rpm at nominal temperatures of ambient, 300{ degree}F, 600{degree}F, 900{degree}F, and 1250{degree}F (149{degree}C, 316{degree}C, 482{degree}C, and 677{degree}C, respectively). The paper gives details of the TP temperature-measurement method, phosphor bonding to the disk, calibration, optical-system design, and electronics instrumentation. The temperatures measured by the TP sensors were compared with those measured by thermocouples mounted on the disk. A number of the thermocouples behaved erratically after we operated the disk at 677{degree}C for an extended period. Nevertheless, for those cases where they could be compared with confidence, the agreement between the TP sensors and the thermocouples was good. 6 refs., 7 figs., 4 tabs.

29402 (Y/DW—718) Evaluation of thresholding heuristics useful for automated filmless radiography. Bell, Z.W. (Oak Ridge Y-12 Plant, TN (USA)). Jul 1987. Contract AC05-84OR21400. 19p. (CONF-870691—12). NTIS, PC A03. Order Number DE88007238/JAW.

From Review of progress in quantitative NDE; Williamsburg, VA, USA (21 Jun 1987).

The human radiographer uses gray-level thresholding and some spatial averaging to discriminate between background and defects on a radiograph image. Both processes are readily applied to digital radiographs by using an image processor. As a region-of-interest identifier, thresholding has the advantages of speed and simplicity, as well as usually requiring a knowledge of only the image histogram. On the other hand, a given thresholding algorithm may be image-specific (only yielding useful results for images with a narrow range of characteristics) and may not be robust with respect to image quality. In this paper, four thresholding techniques are described. They are applied to a simulated digital radiography constructed to test the sensitivity and robustness of the techniques under various conditions of background and signal-to-nosie ratio (SNR). The results of the application are compared and the results of an extensive test of the most promising algorithm are presented. 2 refs., 5 figs.

29403 **Optimization of the analytical performance of an inductively coupled plasma mass spectrometer.** Thompson, J.J. Ames, IA; Iowa State Univ. (1986). 200p. University Microfilms Order No. 87-03,774.Contract W-7405-ENG-82. Thesis (Ph D.).

Methods were found that enable a commercial inductively coupled plasma mass spectrometer to be used in several useful projects, despite its known susceptibility to ionization suppression and drifting of analyte signal. The optimization of instrument and measurement parameters for particular applications is discussed. The role of ultrasonic nebulization and internal standardization is evaluated. Applications to uranium analysis, stable isotope tracing, flow-injection analysis, and liquid chro.natographic detection are given.

45 EXPLOSIONS AND EXPLOSIVES

4501 Chemical

REFER ALSO TO CITATION(S) 29182, 29338

29404 **(AD-A—188694/4/XAB) Material Properties Test 2 (MP-2) review and final data analysis. Final report, May 1985-September 1986.** Rinehard, E.J.; Veyera, G.E. (California Research and Technology, Albuquerque, NM (USA)). Sep 1987. 133p. (CRTA—3751F). NTIS, PC A07/MF A01.

In 1983, three spherical buried high-explosive charges were fired to obtain dynamic material properties for in-situ dry alluvium. This report contains a concise summary describing the test-series objectives, rationale for gaging and placement, overall analysis, and recommendations for future tests. The key question concerning the design was what type of test should be fielded to give the most information about material properties used in calculating nuclear surface bursts. Particular requirements for measurement validation and redundancy of data were also key factors in the design. Several alternate approaches to data analysis by the various participants yielded results that pointed out the ability to determine uniaxially loading parameters of the material; however, stress difference and unloading estimates are still elusive. Important results, described in some detail, are the estimation of the dynamic loading uniaxial strain versus stress relationship, approach to development of a material properties test, analysis of stress gage performance, and recommendations for future material properties testing.

29405 **(AD-A—189121/7/XAB) Current and projected technological threat to NATO theater nuclear forces. Sanitized. Final report, 1 February 1979-31 January 1980.** Gloeckner, D.H.; Carroll, E.A. (Pacific-Sierra Research Corp., Arlington, VA (USA)). 31 Jan 1980. 43p. (PSR—1001). NTIS, PC A03/MF A01.

This study presents estimates for Soviet/Warsaw Pact system characteristics that present a threat to NATO theater nuclear forces. It provides a baseline estimate of current threat while focusing on the characterization of a ten-year projected threat. This study expands on previous work characterizing current and projected threat. This study expands on previous work characterizing current and projected threat systems from a technological point of view to include nuclear, chemical, and biological threat systems.

29406 **(AD-A—189331/2/XAB) Leavenworth papers. Number 10. Chemical warfare in World War I: the American experience, 1917-1918.** Heller, C.E. (Army Command and General Staff Coll., Fort Leavenworth, KS (USA). Combat Studies Inst.). Sep 1984. 114p. NTIS, PC A06/MF A01.

The combat experience of World War I provided the U.S. Army with its first significant exposure to chemical warfare. The purpose of this paper is to show how the Army prepared for this kind of warfare and how soldiers in the American Expeditionary Forces (AEF), from generals to doughboys, adapted or failed to adapt to fighting a war in which chemical weapons played a prominent role. Because no one AEF division experienced every facet of gas warfare, the study will examine information pertaining to many units in order to give a more complete picture of the phenomenon.

29407 **(PB—88-169230/XAB) Environmental aspects of the disposal of explosives.** Verweij, A. (Prins Maurits Lab. TNO, Rijswijk (Netherlands). Inst. voor Chemische en Technologische Research). 1986. 61p. (In Dutch). (PML—1986-8). NTIS, PC E04/MF A01.

The extent of air and soil pollution due to the disposal of ammunition by open-pit burning and detonation by the Netherlands Army was studied and compared with existing environmental norms or correspondingly prevailing values. The study is mainly based on computer-model calculations to simulate open-pit burnings and detonations. Air pollution was derived from dispersion calculations, and in a number of cases the prevailing values will be exceeded. The extent of soil pollution was assessed on the basis of analytical results derived from soil samples taken from a number of munition disposal areas. To keep the extent of air and soil pollution below the environmental norms, a few measures and alternative disposal methods are proposed.

29408 **(UCRL—52000-88-1/2) Energy and Technology Review, January-February 1988.** Lear, R.D.; McGuire, R.; Crawford, R.B.; de Vore, L.; Gleason, K.; Hendry, D.P.; Kirvel, R.D.; Sanford, N.A.; Taft, S.O. (Lawrence Livermore National Lab., CA (USA)). 1988. Contract W-7405-ENG-48. 42p.

An overview of some research programs on high explosives is presented. The following areas are addressed: detonations;diagnostics of the behavior of explosive materials;chemical preparation, fabrication and detonation in accidents. (CS)

4502 Nuclear

REFER ALSO TO CITATION(S) 29169, 29340, 29405

29409 **(AD-A—188271/1/XAB) Analysis of the availability of vehicle nuclear certification information for vehicle maintenance functions. Master's thesis.** Berg, W.F. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Systems and Logistics). Sep 1987. 66p. (AFIT/GLM/LMSA—87S-4). NTIS, PC A04/MF A01.

The objective of this study was to analyze the amount of vehicle nuclear certification information available and to consolidate information pertinent to maintaining USAF vehicles under the guidelines of the Nuclear Weapons Surety Program into a single body of knowledge on which informed maintenance, policy, and inspection decisions could be made. The study examined Federal, DoD, and Air Force guidance as it pertained to the purchase, employment, and maintenance of noncombat delivery vehicles. Analysis of the guidance revealed the conceptual differences between Federal and DoD policy (emphasis on packaging versus emphasis on vehicle), and the comprehensiveness of the Air Force guidance at time of purchase versus the minimal employment and maintenance guidance to assure the long-term certification of the vehicles. Recommendations included enhanced training for mechanics and increased involvement of maintenance management to facilitate assurance of the long-term certification of vehicles.

29410 **(AD-A—189122/5/XAB) Soviet strategic nuclear targeting. Sanitized. Final report, 1 March 1978-31 January 1979.** Lee, W.T. (Center for Planning and Research, Inc., Bailey's Crossroads, VA (USA)). 31 Jan 1979. 26p. NTIS, PC A03/MF A01.

This report investigated Soviet Strategic Nuclear Targeting procedures against a limited target set. Included are objectives, doctrine, tactics, and an evaluation of nuclear weapons effects against selected target categories as viewed from Soviet Perspective.

29411 **Long-term consequences of and prospects for recovery from nuclear war: Two views. View II.** Anspaugh, L.R. (Lawrence Livermore National Lab., Livermore, CA (US)). pp 566-582 of The medical implications of nuclear war. Solomon, F.; Marston, R.Q. Washington, DC; National Academy Press (1986). Contract W-7405-ENG-48.

The author comments on the information presented in this volume and speculates on the long-term consequences of nuclear war and the prospects for recovery. In order to do that, it might be useful to define long term. To him this means time frames of years to perhaps even hundreds of years in terms of the ultimate response and recovery of large-scale ecosystems. Such long time frames may seem excessive, but if some of the speculated efforts of nuclear war are actually realized, it may indeed take centuries before native ecosystems restabilize. Also, when referring to long-term effects of the magnitude required to have a major impact on entire ecosystems, it is clear that the driving force would not be the direct effects of nuclear war. Of potentially greater significance would be the secondary effects mediated by the intermediate-term impacts on global climate. Specifically, he refers to the speculative impacts of major decreases in the heat and light fluxes reaching the Earth's surface. Such changes are commonly referred to as "nuclear winter."

4503 Explosion Detection

REFER ALSO TO CITATION(S) 28912

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

5001 Basic Studies

REFER ALSO TO CITATION(S) 28839, 29426

5002 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 28838, 28839, 28865, 28866, 28867, 28871, 28878, 29155, 29162, 29166, 29407, 29428

29412 **(AD-A—188420/4/XAB) Fibrous-glass aerosols: a literature review. Special report.** Laverty, B.R. (Naval Submarine Medical Center, Groton, CT (USA). Submarine Medical Research Lab.). 2 Oct 1987. 21p. (NSMRL-SR—87-2). NTIS, PC A03/MF A01.

The submarine atmospheric is a topic of interest, considering that once submerged, the craft relies on its own electrostatic precipitators (ESP's), scrubbers, and filters to create, ideally, an environment with minimal aerosolized toxic materials and other by-products. Historically, atmosphere sampling aboard nuclear submarines has shown contaminants. Other contaminants include: ozone, (major source: by-product of the ESP's); freon, (major source: ship's refrigeration system and air-conditioning plants); hydrogen, (major source: ship's batteries); carbon dioxide, (major source: human respiration); and carbon monoxide, (major source: cigarette smoking). Contaminants tested for but not found were elemental mercury and asbestos. Considering that asbestos is no longer recommended for use, secondary to its carcinogenic and co-carcinogenic qualities, fibrous glass has become a common substitute. One use of fibrous glass aboard the Ohio class submarine is acoustic and thermal insulation around perforated ducting, which runs through many exposed, high traffic spaces, i.e. crew's berthing spaces. Although the raw fibrous glass is protected from the environment it is possible, through natural wear and tear of the housing material, that at some time the insulating material may become exposed and mechanically aerosolized. Obvious questions then are: a) do submarine aerosols contain fiber glass, and b) are there health hazards related to the inhalation of these fibers. This paper reviews the current knowledge as to the health hazard of exposure.

29413 **(BNL—52132) Uncertainty analysis of the NAPAP [National Acid Precipitation Assessment Program] emissions inventory:.** Benkovitz, C.M.; Oden, N.L. (Brookhaven National Lab., Upton, NY (USA)). Dec 1987. Contract AC02-76CH00016. 58p.

The National Acid Precipitation Assessment Program (NAPAP) was established by Congress in 1980 to coordinate and expand research relevant to acid deposition in North America. The Interagency Task Force on Acid Precipitation (ITFAP) manages the program through eight subordinate task groups that coordinate specific technical areas of research. Task Group I coordinates the research in the areas of man-made pollution sources and their control technologies. A major goal of Task Group I is the development and maintenance of detailed inventories of anthropogenic emissions. The Acid Deposition Emission Inventory Plan, prepared as one of the EPA contributions to Task Group I, identifies the need for emissions inventories of current base years to support both assesment activities and the development, evaluation and use of long-range transport and transformation models. The uncertainty estimates of emissions data are an integral part of the inventory. In a previous project, a basic statistical framework was developed to assess the uncertainties associated with the emissions data as presented in the NAPAP emissions inventory. Work has continued in two parallel directions: adaptation of the statistical methodologies previously developed for use in conjunction with the NAPAP 1980 base year inventory and continued study of the sources of uncertainty in the NAPAP 1985 base year emissions calculation, with development of statistical methodologies to properly account for these uncertainties. This report details the work accomplished during FY 1986. 7 refs., 3 tabs.

29414 **(PB—88-161682/XAB) Complex-Terrain Dispersion Model - computer and source code (for microcomputers). Model-Simulation.** Perry, S. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). 1 Feb 1988. vp. (EPA—600/8-87/058). NTIS CP D99.

See also PB—88-162169, and PB—87-103586; The software is contained on 5 1/4-inch diskette, double sided, double density compatible with the IBM PC/XT microcomputer. Diskettes are in the ASCII format. Price includes documentation, PB—88-162094 through PB—88-162136.

The Complex Terrain Dispersion Model (CTDM) is a refined air-quality model for use in stable and neutral conditions in complex-terrain applications. Its use of meteorological input data and terrain information is different than current EPA models; considerable detail for both types of input data are required and are supplied by preprocessors specifically designed for CTDM. CTDM requires the parameterization of individual hill shapes using the terrain preprocessor and the association of each model receptor with a particular hill (except for receptors in flat terrain, which CTDM can also handle). A central feature of CTDM is its use of a critical dividing-streamline height (Hc) to separate the flow in the vicinity of a hill into two separate layers. Flow in the upper layer has sufficient kinetic energy to pass over the top of the hill while streamlines in the lower layer are constrained to flow in a horizontal plane around the hill.

29415 **(PB—88-162169/XAB) Complex-Terrain Dispersion Model - computer code (for microcomputers). Model-Simulation.** Perry, S. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). 1 Feb 1988. vp. (EPA—600/8-87/058). NTIS CP D99.

See also PB—88-161682, and PB—87-103586; The software is contained on 5 1/4-inch diskette, double sided, double density compatible with the IBM PC/XT microcomputer. Diskettes are in the ASCII format. Price includes documentation, PB—88-162094 through PB—88-162136.

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29416 **(PB—88-163019/XAB) Toxic Air Pollutant/ Source Crosswalk: Information Storage and Retrieval System User's Manual. Final report.** (Pacific Environmental Services, Inc., Durham, NC (USA)). Dec 1987. 61p. NTIS, PC A04/MF A01.

See also PB—88-161146.

This report presents instructions on the Toxic Air Pollutant Crosswalk System that was developed to allow easy access and updates to the crosswalk data presented in the accompanying EPA report, Toxic Air Pollutant/Source Crosswalk - A Screening Tool For Locating Possible Source-Emitting Toxic-Air Pollutants, EPA-450/4-87-023a. The software system is an IBM PC based application that contains a listing of industrial source categories (SIC Codes), emitting-source classifications (SCC codes), and their likely associated pollutants. The crosswalk program has modules that allow users to add, delete, edit, or browse specific data and to print tables contained in the accompanying crosswalk document. EPA is making available the system and data and data-base records to agency users on three high-density diskettes. The purpose of the report is to document the usage of the system. The system was designed as a tool to develop the report, Toxic Air Pollutant/Source Crosswalk - A Screening Tool For Locating Possible Sources Emitting Toxic Air Pollutant.

29417 **(PB—88-165352/XAB) Environment pollution by tobacco. Impact on non-smokers. Study of various processes to purify the atmosphere.** Hee, J.; Isoard, P.; Malaspina, J.P.; Radziszewski, E. (Centre d'Etudes et de Recherche Technique Sous-Marines (CERTSM), 83 - Toulon Naval (France)). 30 Sep 1987. 137p. (In French). NTIS, PC E07/ MF E07.

Air pollution through cigarette smoke produced by smokers or by a cigarette-smoking machine in an air-conditioned chamber has made it possible to study the evolution of particulate and gaseous pollution. Contrary to purification by open-circuit ventilation, purification by closed-circuit filtration is selective. The efficiency of the various filters considered varies according to the particle-size class considered. Particulate filtration can increase the concentration of volatile products, especially irritants. Eye irritation seems to be essentially related to the formaldehyde content of the air. The 'dose' of smoke absorbed by non-smokers in the conditions of very severe exposure amounted to active smoking of about one cigarette. The estimate must be weighted for each constituent, taking into account the ratio of the product quantities produced, respectively, in the sidestream and mainstream smoke.

29418 **(PB—88-167309/XAB) Effectiveness of BMPs (Best Management Practices) for stormwater management in urbanized watersheds.** Kuo, C.Y.; Loganathan, G.V.; Cox, W.E.; Shrestha, S.P.; Ying, K.J. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Virginia Water Resources Research Center). Jan 1988. 115p. (VPI-VWRRC-Bull—159). NTIS, PC A06/MF A01.

The Illinois Urban Drainage Area Simulator (ILLUDAS) has been modified for continuous simulation and a water-quality module has been added to it. The continuous simulation model updates the Antecedent Moisture Condition (AMC) based on the rainfall information up to 120 hours prior to the beginning of a storm and the information on the number of dry days between storms is utilized to compute the pollutant build-up which also depends on the street sweeping interval. The water-quality module utilizes the dust and dirt method of STORM to compute pollutant accumulated on the watershed surface. Pollutant washoff is then computed based on the assumption of first-order kinetics. Features were added to simulate the effect of BMP structures. Infiltration trenches and detention ponds were considered in the study. An optimization scheme was adopted to optimally size and locate the detention structures within the watershed.

29419 **(PB—88-168042/XAB) Emissions and control of offensive odor in wastewater treatment plants. Technical report.** Wang, L.K. (Lenox Inst. for Research, Inc., MA (USA)). 23 Apr 1985. 32p. (LIR—04-85/130). NTIS, PC A03/MF A01.

A thorough literature review, with 96 references, of odorous pollution sources, main odorants, odor quantification, dispersion, control methods, and health effects was conducted and documented.

29420 **(PB—88-168059/XAB) Recent advances in odor-pollution abatement - a computer search. Technical report.** Wang, L.K. (Lenox Inst. for Research, Inc., MA (USA)). 30 Apr 1985. 57p. (LIR—04-85/136). NTIS, PC A04/MF A01.

Under the sponsorship of the City of Springfield, MA, Lenox Institute for Research completed a computer search on odor-pollution-control technologies currently being used in municipal and industrial wastewater-treatment plants.

29421 **(PB—88-171038/XAB) Design considerations for ozone and acid-aerosol exposure and health investigations: the Fairview Lake Summer Camp - photochemical smog case study.** Lioy, P.J.; Spektor, D.; Thurston, G.; Citak, K.; Lippmann, M. (Robert Wood Johnson Medical School, Piscataway, NJ (USA). Dept. of Environmental and Community Medicine). 1987. 15p. NTIS, PC A03/MF A01.

Pub. in Environment International, Vol. 13, 271-283(1987).

The health effects associated with ozone and acidic particulate sulfate exposures to active children have been and are being addressed in field epidemiological studies at summer camps in rural areas of the Northeastern U.S. The rationale and study design for studies, which have been conducted in Pennsylvania and New Jersey, are developed and reviewed. As background, results are summarized for human clinical and epidemiological studies and animal studies. These provided the basis for selection of health outcomes. Measured results from chemical characterization and transport studies are reviewed to define the criteria used for selection of a site affected by high ozone and acid species during photochemical smog episodes. The integration of the study design is discussed in detail by reviewing its application to the 1984 - Fairview Lake Camp Study (July 8 to August 4). The features of the camp study are reviewed, including the study population, pulmonary function procedures and analyses, air pollution monitoring instrumentation, and the site characteristics.

29422 **The acid deposition assessment model: An integrated framework for benefit and cost analysis.** Marnicio, R.J.; Rubin, E.S.; Small, M.J.; Henrion, M. (Center for Energy and Environmental Studies, Carnegie-Mellon Univ., Pittsburgh, PA 15213 (US)). pp 214-221 of Proceedings of the seventh world clean air congress. Eastwood, NSW Australia; Clean Air Society of Australia and New Zealand (1986). (CONF-860803—).

From 7. world clean air congress and exhibition; Sydney, Australia (25 Aug 1986).

A comprehensive acid deposition assessment model (ADAM) is under development to facilitate studies of acid deposition and its control. The framework links models of pollutant emissions; atmospheric conversion and transport; acidic deposition; lake acidification; fish viability; forest productivity; and damages to selected man-made materials. These models are nominally derived from more detailed models and data which represent the current state of science in each area. Simpler models, including representations of expert judgment, also can be employed. A comparative economic framework is established through the incorporation of

user-specified valuation relationships, and cost models for emission controls and impact mitigation. The framework is designed to allow alternate assumptions or hypotheses to be easily tested in interactive fashion for preliminary assessment purposes and research management. The framework is implemented in a software system designed to facilitate the analysis of model and parameter uncertainties. An interactive menu-based interface also has been developed to facilitate use of the model. The model's use for assessment purposes is illustrated, and plans for its continued development are described.

29423 **Influence of vapor pressure on vapor-particle partitioning of trace organic pollutants.** Foreman, W.T. Columbia, SC; Univ. of South Carolina (1986). 266p. University Microfilms Order No. 87-04,626.

Thesis (Ph. D.).

Particle (P) and vapor (V) phase polycyclic aromatic hydrocarbons (PAH) at the Savannah River Plant were collected using a filter-polyurethane foam (PUF) plug hi-vol sampler. PUF was retentive for gaseous 3-ring PAH when air volumes not exceeding 600 m^3 were sampled on warm days. PAH breakthrough on PUF was governed by the liquid-phase vapor pressure (p/sub L/°) rather than the solid phase (p/sub S/°). The apparent VP partitioning of PAH, as estimated by [A(TSP)F] where A and F are the adsorbent- and filter-retained SOC concentrations and TSP is the total suspended particle concentration also correlated well with p/sub L/°. An apparatus was designed to equilibrate urban air particulate matter on a filter with controlled vapor concentrations of semivolatile organic compounds (SOC) at 20°C under simulated air sampling conditions. VP for organochlorine pesticides and 3-4 ring PAH were estimated from laboratory measurements of A(TSP)F. Measured A(TSP)F correlated well with (p/sub L/°) of the SOC tested, but not with p/sub S/°. Comparisons of field and laboratory A(TSP)F were made and implications of p°-dependent partitioning to the atmospheric chemistry of SOC are discussed.

29424 **Measurement of sulfur dioxide in the post-combustion environment.** Lucas, D.; Morrow, M.D.; Brown, N.J. Berkeley, CA; Lawrence Berkeley Laboratory (1984). 7p. Contract AC03-76SF00098.

Tunable Atomic Line Molecular Spectroscopy (TALMS) has been used to measure sulfur dioxide in the post flame region of an atmospheric pressure stoichiometric methane/air flame. The technique is sensitive and highly selective and thus is useful for research and commercial applications. Response is linear to 20,000 ppm in a 7 cm path length, with a limit of detection of ~ 2000 ppm at 1500 K and ~ 40 ppm at 300 K. Ultraviolet absorption spectra of SO_2 were recorded in the 205 to 220 nm range at various temperatures, and reveal significant broadening due to redistribution of rotational level population at the higher temperatures, and no interference from other combustion products. TALMS signal dependence on magnetic field strength confirms that the same transition is observed in the flame as at room temperature. Fluorescent quenching of SO_2 by combustion products was measured in a Thermo Electron model 40 analyzer. Stern-Volmer plots are linear and yield relative quenching coefficients which increase in the order: Ar, CO_2, O_2, H_2, CH_4, CO, and C_6H_6. Significant quenching corrections are needed to accurately determine SO_2 concentrations in combustion mixtures, especially for the case of rich combustion, where large concentrations of CO, unburned hydrocarbons, and aromatic soot precursors may be present. 28 references, 6 figures, 1 table.

5003 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 29411

29425 **(KFK—4345) Pb-210 in ground-level air and snow in the environment of the Karlsruhe Nuclear Research Center.** Parveen, N.; Schuettelkopf, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Hauptabteilung Sicherheit). Jan 1988. 16p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753390/JAW.

Pb-210 concentrations in air and snow were measured near the Karlsruhe Nuclear Research Center (KfK). The results revealed that the Pb-210 concentrations in air near the KfK are lower by a factor of 1.5 to 2.0 compared to those in others parts of Germany. According to these results the Pb-210 concentration in snow is lower than the expected values for the middle latitudes of the northern hemisphere. These low values may be a consequence of the low content of natural radioactivity in the soil of the river Rhine valley. The deposition rate of Pb-210 aerosols on snow is extremely low. The low deposition can be explained by a combined effect of lower deposition velocity and an increased resuspension for Pb-210 aerosols on ice-covered snow layer.

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

5101 Basic Studies

29426 **(PB—88-160841/XAB) Guidelines for measuring the physical, chemical, and biological condition of wilderness ecosystems. General technical report (Final).** Fox, D.G.; Bernabo, J.C.; Hood, B. (Forest Service, Fort Collins, CO (USA). Rocky Mountain Forest and Range Experiment Station). Nov 1987. 56p. (FSGTR-RM—146). NTIS, PC A04/MF A01.

Guidelines include a large number of specific measures to characterize the existing condition of wilderness resources. Measures involve the atmospheric environment, water chemistry and biology, geology and soils, and flora. Where possible, measures are coordinated with existing long-term monitoring programs. Application of the measures will allow more effective evaluation of proposed new air-pollution sources.

5102 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 29276, 29407, 29439

29427 (DOE/ER—0343, pp 18-20) **Immunoassays for monitoring exposure to toxic chemicals.** Vanderiaan, M.; Stanker, L.; Watkins, B. 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.).

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

In this presentation the basic principles of monoclonal-antibody-based immunoassays for toxic chemicals are presented. A background to the current state-of-the-art is provided. Results of the immunoassay of aromatic amines in cooked beef are discussed as an illustration of monoclonal antibody development.

29428 (DOE/ER—0343, pp 21) **Development of an immunoassay for chlorinated dioxins.** Stanker, L.; Watkins, B.; Vanderlaan, M. 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.).

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

The development of a set of monoclonal antibodies (mabs) to dioxin, referred to as DD-1, DD-3, DD-4, DD-5, and DD-6 is reported. Antibody binding is related to the level of chlorine substitution. The antibodies preferentially bind the tetrachloro- and pentachlorodibenzodioxins including 2,3,7,8-TCDD. Thus, they bind the most toxic isomers. Dibenzofurans also are recognized but for the most part the mabs do not recognize PCBs or the chlorinated pesticides that have been analyzed. Using these antibodies a competition enzyme-linked immunosorbent assay (c-ELISA) has been developed which can easily detect a few hundred picograms of 2,3,7,8-TCDD. This assay is being adapted to detect dioxin in soils and in fly ash from municipal waste incinerators and cogeneration plants. It is hoped that this assay may be applied to biological matrices.

29429 **Precipitation chemistry: Its behavior and its calculation.** Hales, J.M. (Battelle Pacific Northwest Labs., Richland, WA (US)). pp 211-252 of Air pollutants and their effects on the terrestrial ecosystem. Legge, A.H.; Krupa, S.V. New York, NY; John Wiley and Sons Inc. (1986).

As our understanding of the atmospheric sciences has evolved it has been marked increasingly by the compelling need to develop generalized and simple, yet reliable methods for assessing the impacts of man-made change. Development of such procedures has always been characterized by a tradeoff between simplicity on the one hand and reliability on the other; and although limited accuracy and overextended application have continued to pose problems, some rather remarkable successes have been achieved. Similar successes in the field of precipitation chemistry have been comparatively limited, owing the the complexity of the scavenging process. Some notably elegant inroads have been established, but these have focused on limited subsets of the overall scavenging problem, and cannot be extended for generalized, reliable usage. In aggregate, however, these assorted techniques compose a useful means of attacking the extended scavenging problem. One can look to a composite set of techniques which is generally useful on an applied basis. The purpose of this paper are two-fold. The first of these is to present a rational basis for examining this aggregate set of scavenging-calculation techniques, and for guiding the reader in a course toward choosing the most appropriate technique for a particular application. The second purpose of this paper is to present a somewhat brief survey of our current understanding of scavenging and precipitation chemistry. Both objectives are implemented by a flowchart approach, which attempts to draw the various facets of scavenging calculations together and present a generalized approach to the problem in total.

29430 **Characterization and quantification of the oxides of sulfur and nitrogen and associated compounds in their gaseous, aerosol, and dissolved states.** Newman, L. (Environmental Chemistry Div., Dept. of Applied Science, Brookhaven National Lab., Associated Universities, Inc., Upton, NY (US)). pp 159-174 of Air pollutants and their effects on the terrestrial ecosystem. Legge, A.H.; Krupa, S.V. New York, NY; John Wiley and Sons Inc. (1986).

The observation of a physical change frequently can be utilized as a measure of the result of the effects of air pollutants on terrestrial ecosystems. However, an understanding of the mechanisms through which pollutants bring about these changes can be accomplished only through chemical analysis of those constituents potentially causing the stress to the ecosystem. The nature and type of measurements that need to be made to come to this recognition and the authors ability to make them are the subjects of this discussion.

5103 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 28906, 28916, 29411, 29439

29431 (DOE/ER/75172—5, pp 27) **Radon gas: detection techniques, health impacts and reduction methods.** Smith, E.J. (Arizona State Univ., Tempe (USA)). 1987. NTIS, PC A06/MF A01. Order Number DE88005041/JAW. (CONF-8703231—Summs.).

From Western region American Nuclear Society student conference: nuclear technology for the year 2000; Albuquerque, NM, USA (19 Mar 1987).

Radon-222, a decay product of Uranium, is found to be radioactively contaminating homes throughout the US and causing hazardous working conditions for uranium miners. Radon gas decays to various heavy metal isotopes of polonium, bismuth and lead which in turn emit alpha particles. Despite an alpha particle's shallow penetration distance of approximately 20 microns, biological damage can be extensive if ingested, possibly resulting in lung cancer. The toll of lung cancer fatalities due to Radon exposure is estimated at 20,000 per year in the US. Statistical surveys approximate that 7% of homes in the US, or roughly four million, exceed the 4 picocurie per liter limit set by the EPA at which remedial action is recommended. In the Uranium mining industry, the common unit of measurement for radon radiation, the working level (WL), is set at a maximum of 4 WL per month per year. The instruments presently available to measure and monitor radon levels are: Working Level Meters, Charcoal Filters, and Track Etch Detectors. Construction Technology to reduce radon levels can be as easy as installing ventilation system and sealing off entry routes of radon gas. The paper will provide an overview of radon sources, detection techniques, the health impact on the public and construction technology in the reduction of radon levels.

29432 (DOE/ER/75172—5, pp 29-38) **Soil assessment around Palo Verde area.** Moon, Y. (Arizona State Univ., Tempe (USA)). 1987. NTIS, PC A06/MF A01. Order Number DE88005041/JAW. (CONF-8703231—Summs.).

From Western region American Nuclear Society student conference: nuclear technology for the year 2000; Albuquerque, NM, USA (19 Mar 1987).

The Arizona State University Radiation Monitoring Facility in conjunction with ANPP performs annual radiological assessment of soil samples obtained from 65 sites, located 0, 1/4, 1, 5, 50 miles away surrounding the Palo Verde Nuclear Generating Station (PVNGS). The purpose of the assessment is to obtain information of radioactivity caused by both natural and man-made in the soils such as, Ra-226, Bi-214, Pb-214, Th-228, K-40, and Cs-137. There are wide range of background radiation exists because of the different soils and geological conditions. Although there are wide range, average values obtained in 1987 are closely related when compared with 1985 and 1986 PVGNS Environmental Control Program and Oak Ridge National Laboratory findings. The average value of K-40 was obtained to be 21.4 pCi/gram compared to 20.6 and 19.7 in the 1985 and 1986 radiation readings. Cesium (137), which was also abundant in most samples, was found to be 0.076 pCi/gram as compared to 0.21 and 0.17 for 1985 and 1986 radiation monitor studies. The radioactive equilibrium was found to exist in nearly all samples for the thorium decay series, and in most samples for the uranium chain.

29433 (INIS-mf—11665) **On the behaviour of the long life fission product iodine 129 in the biosphere and radiation dosage of human beings.** Robens, E. (Bonn Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet). 7 Nov 1986. 255p. (In German). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88753301/JAW.

The I-129 and I-127 content of soil samples, foodstuffs and feedstuffs samples from the vicinity of the Karlsruhe reprocessing plant (WAK) was determined, in order to obtain an idea of how I-129 reaches human beings via the different load paths. The soil samples originate from the sector in the direction of the prevailing wind at WAK. The depth distributions and dwell halflife times of I-129 were determined. The calculation of transfer factors for the transition soil/plant followed from the I-129 concentration. The I-129 concentration in the soil and in plants at the sampling positions were calculated using a radio-ecological propagation model and were compared with experimental values. The thyroid gland doses of 2.6x10/sup -5/ rem/annum for adults and 4.5x10/sup -6/ rem/annum for small children were determined.

29434 **(SKB-TR—87-04) Calculations on HYDROCOIN level 2, case 1 using the GWHRT flow model. Thermal convection and conduction around a field heat transfer experiment.** Thunvik, R. (Royal Inst. of Tech., Stockholm (Sweden)). (Swedish Nuclear Fuel and Waste Management Co., Stockholm; Royal Inst. of Tech., Stockholm (Sweden)). Mar 1987. 41p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753309/JAW.

The report presents solutions to Hydrocoin Level 2: Case 1, dealing with thermal convection and conduction around a field heat transfer experiment. Hydrocoin is an international cooperation project to compare different computer models used for describing groundwater flow in geological media. The purpose of the project is to improve the understanding of various strategies for modelling groundwater flow for the safety assessment of final radioactive waste repositories. The project is structured in three levels. The object of level 2 is to study the capability of computer models to describe in-situ measurements.

5105 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 28837

52 ENVIRONMENTAL SCIENCES, AQUATIC

5202 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 28909, 28910, 29399, 29419, 29420

29435 **(PB—88-168034/XAB) Recent advances in magnetic processes. Technical report.** Krofta, M.; Wang, L.K.; Wu, B.C.; Rogalla, F. (Lenox Inst. for Research, Inc., MA (USA)). 20 Apr 1985. 33p. (LIR—04-85/129). NTIS, PC A03/MF A01.

Various magnetic-separation processes including magnetic coagulation/sedimentation, magnetic filtration, magnetic ion exchange, and magnetite addition are reviewed. Their general theories and principles are described. Their various applications in water and wastewater are introduced with special emphasis on removals of oil scale and heavy metals.

29436 **(PB—88-168448/XAB) Dissolved air-flotation processes. Technical report.** Krofta, M.; Wang, L.K. (Lenox Inst. for Research, Inc., MA (USA)). 5 Nov 1986. 38p. (LIR—11-86/219). NTIS, PC A03/MF A01.

The theories and applications of various dissolved-air-flotation clarifiers (Supracell, Sandfloat, Floatpress, and Sedifloat) are presented. Supracell is a high-rate dissolved-air-flotation clarifier with only 3 to 5 minutes of detention time. Major application of Supracell is industrial-effluent treatment. Sandfloat is a package plant consisting of flocculation, dissolved-air floatation and automatic backwash filtration, and designed for either potable water treatment or tertiary wastewater-treatment. Sedifloat is a wastewater-treatment package plant consisting of both sedimentation and dissolved-air flotation. Floatpress consists of both dissolved air flotation and filter press and is specifically designed for sludge thickening. A Krofta Bargefloat is a floating lake-water clarification plant designed for acid-rain neutralization, phosphorus removal, algae removal and lake-water purification. Bargefloat has built-in chemical feeders, flocculator, dissolved-air-flotation clarifier and sand filter on a barge.

29437 **(PB—88-170485/XAB) Predictive modeling of organic emissions.** Berglund, R.L.; Whipple, G.M. (Union Carbide Corp., South Charleston, WV (USA)). 1987. 12p. NTIS, PC A03/MF A01.

Pub. in Chemical Engineering Progress, Vol. 83, No. 11, 46-54(Nov 1987).

The purpose of the study was to develop and utilize sampling, analytical, and predictive methods to assess the fate of selected chemicals in a full-scale wastewater treatment facility by monitoring a wastewater treatment facility which received wastewater from a large petrochemical plant. The treatment facility consisted of (1) neutralization, (2) equalization, (3) aerated stabilization and (4) UNOX treatment. Eight chemicals were monitored. These included four volatile chemicals (benzene, toluene, 1,2 dichloroethane, and ethyl benzene) and four semi-volatile chemicals (tetralin, 2-ethyl hexanol, 2-ethyhexylacrylate, and naphthalene). Extensive sampling of the air, water and sludge streams around each of the wastewater treatment unit operations was conducted for a three-week period during August 1983.

29438 **(PB—88-175757/XAB) NOAA Estuary-of-the-Month Seminar Series No. 1. Narragansett Bay: issues, resources, status and management.** (National Oceanic and Atmospheric Administration, Washington, DC (USA). Estuarine Programs Office). Aug 1987. 176p. (NOAA-EPO—87/01). NTIS, PC A09/MF A01.

See also PB—83-262089.

This report contains papers presented at a seminar on Narragansett Bay on January 28, 1985 with the objective of bringing to the public attention the important research and management issues in the Bay. The many issues concerning the health and value of the Bay are considered dealing with subjects ranging from waste crankcase-oil disposal to sociological concerns. First an overview is given then explanations of Bay economics, pollution inputs, circulation dynamics, and management issues.

29439 **Development of waste tracking systems for the planning and analysis of large-scale leaching experiments.** Rivera, A.L.; Genung, R.K. (Oak Ridge National Lab., TN (USA)). pp 254-255 of 194. National Meeting of American Chemical Society, Division of Environmental Chemistry. Washington, DC; American Chemical Society (1987). (CONF-870802—). Contract AC05-84OR21400.

From 194. American Chemical Society national meeting; New Orleans, LA, USA (30 Aug 1987).

This paper discusses the considerations necessary in the development of waste management systems. Site characteristics, waste forms, and disposal methods are addressed. The importance of large-scale leaching experiments in determining possible toxic effects is emphasized.

5203 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 28909, 28910, 28911, 28916, 28921, 29073, 29434, 29439

29440 **(IG—87/01) Tritium content of precipitation and surface water in Austria in 1986.** Rank, D.; Rajner, V.; Lust, G. (Bundesversuchs- und Forschungsanstalt Arsenal, Vienna (Austria)). 1987. 35p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702565/JAW.

This report includes weighted monthly ^{3}H-means from 23 precipitation sampling stations, ^{3}H-concentrations of daily precipitation samples from the station Wien-Arsenal, and ^{3}H-concentrations of monthly samples from 17 surface water sampling stations of the year 1986.

29441 **(INIS-BR—1010) Methods for determining fluid flow using radioactive tracers.** Duarte, U. (Sao Paulo Univ. (Brazil). Inst. de Geociencias). 1973. 121p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88702594/JAW.

The measuring methods of flow using tracer techniques are described. The advantages of these methods and the facilities to use radioisotopes in surface hydrology are presented. (M.C.K.).

29442 **Seasonal distribution and uptake of gamma emitting radionuclides at the test reactor area leaching ponds.** Millard, J.B. Fort Collins, CO; Colorado State Univ. (1986). 205p. University Microfilms Order No. 87-05,473.

Thesis (Ph. D.).

Radioactive leaching ponds adjacent to the Test Reactor Area (TRA) located on the Idaho National Engineering Laboratory (INEL) site were investigated to determine the seasonal distribution and ecological behavior of gamma emitting radionuclides in various pond compartments. The physical, chemical and biological properties of the TRA ponds were documented including basic morphometry, water chemistry and species identification. Penetrating radiation exposure rates at the ponds ranged from 35 to 65 mR/d at the water surface and up to 3400 mR/d one meter above bottom sediments. Seasonal concentrations and concentration ratios were determined for 16 principle radionuclides in filtered water, sediment, seston, zooplankton, net plankton, nannoplankton, periphyton, macrophytes, thistle, speedwell and willow. Seston and nannoplankton had the highest concentration ratios with substantial decreases observed for higher trophic level compartments. Significant ($P < 0.01$ to $P < 0.001$) seasonal effects wee found for concentration ratios. Radionuclides without nutrient analogs had the highest ratios in spring for periphyton, macrophytes and littoral plants. Concentration ratios were highest in summer, fall or winter for radionuclides with nutrient analogs.

5206 Regulations

29443 **(PB—88-149810/XAB) Improved streamflow and water-quality monitoring using a microprocessor-based system. Forest Service research note.** Babbitt, R.E. (Forest Service, Ogden, UT (USA). Intermountain Research Station). Nov 1987. 8p. (FSRN/INT—377). NTIS, PC A02/MF A01.

The report describes microprocessor-based data acquisitions system for monitoring streamflow and collecting water samples at remote sites. The system was more efficient and provided more precise data during high-intensity, short-duration rainstorms than the system used previously.

53 ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

5302 Assessment Of Energy Technologies

29444 **(EIS—87-0206(Final)) Decommissioning of the Humboldt Bay Power Plant, Unit No. 3, Docket No. 50-133, Humboldt County, California.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Apr 1987. 162p. (NUREG—1166). Cambridge Scientific Abstracts, 5161 River Rd., Bethesda, MD 20816.

EPA No. 870171F; NRC.

Environmental impacts associated with the SAFSTOR option for decommissioning the Humboldt Bay Power Plant, Unit 3, located four miles southwest of the city of Eureka in Humboldt County, California, are assessed. Humboldt Bay Unit 3, a 65-MWe boiling water reactor, was operated commercially from August 1963 until July 1976, at which time it was shut down for seismic modifications. The facility would be stored safely for approximately 30 years. Estimated annual purchases of materials and supplies resulting from SAFSTOR activities are expected to be $20,000 (1984 dollars), and these purchases are expected to be made in Humboldt County. A fuel-handling accident would result in atmospheric radionuclide releases that are well below EPA Protective Action Guide (PAG) levels. Damage to all the stored-fuel assemblies resulting from a nonmechanistic heavy-load drop would result in atmospheric radionuclide releases that are also well below the PAG levels. There is a negligibly small likelihood that seismic loads or other mechanical loads would generate criticality among the spent fuel assemblies stored in the pool. The upper limits of potential lung, liver, and bone doses resulting from an instantaneous expulsion to the atmosphere of the entire water/radionuclide content of the spent-fuel pool are very small fractions of the PAG levels. A rupture of the spent-fuel pool or the liquid radwaste tanks would result in a total body dose to an average individual via the seafood chain that would be less than the dose from natural background levels. Doses from recreational activities in Humboldt Bay would be negligible.

29445 **(EIS—87-0207(Draft)) Remedial actions at the former Union Carbide Corporation uranium mill sites, Rifle, Garfield County, Colorado.** (Department of Energy, Albuquerque, NM (USA). Albuquerque Operations Office). May 1987. vp. (DOE/EIS—0132-D). Cambridge Scientific Abstracts, 5161 River Rd., Bethesda, MD 20816.

EPA No. 870184D; DOE.

Cleanup of the contaminated materials at the mill sites and associated vicinity properties at Rifle in Garfield County, Colorado is proposed. The Rifle tailings sites consist of the separate Old and New Rifle tailings sites. Together, the Old and New Rifle sites cover 164 acres of private land and contain approximately 3.5 million cubic yards of tailings and associated contaminated soils. The tailings were produced by the Union Carbide Corporation when it processed vanadium and uranium ores from 1924 to 1932 and from 1942 to 1973. If the the tailings are properly stabilized, erosion or human removal of the contaminated materials cannot spread the contamination over a much wider area and increase potential public health hazards. Approximately 164 acres of land would be released for other uses. Primary impacts of the preferred alternative would be the temporary exceeding of federal and state air quality standards; disturbance of residents-near and between the Rifle, Estes Gulch, and borrow sites during the daytime from noise generated by construction and transportation activities; and increased traffic on US Highway 6 and State Highway 13, with associated increases in accidents, congestion, and highway maintenance.

29446 **(EIS—87-0218(Draft)) California-Oregon transmission project and the Los Banos-Gates transmission project, California, Oregon, and Washington (draft supplement to the draft environmental impact statement of November 1986).** (Department of Energy, Sacramento, CA (USA). Western Area Power Administration). Jun 1987. 130p. (DOE/EIS—0128). Cambridge Scientific Abstracts, 5161 River Rd., Bethesda, MD 20816.

EPA No. 870227DS; DOE.

Expansion and reinforcement of the Pacific Northwest-Pacific Southwest (PNW-PSW) Intertie by electrical transmission projects of public and privately owned utilities are proposed in California, Oregon, and Washington. The projects have multiple purposes and would essentially provide a third 500-kilovolt (kV) alternating current (AC) transmission path between southern Oregon and central California (California-Oregon Transmission Project (COTP)); complete a third 500-kV AC transmission path in the San Joaquin Valley of California (Los Banos-Gates Transmission Project); and reinforce the existing 500-kV AC transmission system facilities in Oregon and southern Washington (Pacific Northwest (PNW) Reinforcement Project). The Transmission Agency of Northern California, Western Area Power Administration (WAPA), and privately owned utilities and additional public entities propose to build an approximately 340-mile-long 500-kV AC transmission line from southern Oregon to the Tesla Substation in central California for the COTP. The proposed actions would expand the bidirectional capability of the PNW-PSW Intertie transmission system and would help serve California's need for economical power, the PNW's desire to self surplus power, and the need for maintaining and increasing the reliability of the existing transmission system. Potential adverse effects include excessive wind and water erosion. Wildlife effects include the possibility of collision of special-status and sensitive bird species or waterfowl with conductors and shield wires. Land-use impacts include crossing prime timberland prime farmland, and agricultural preserves. Visual effects would be reduced, but would remain significant following application of mitigation measures.

29447 **(EIS—87-0220(Draft)) Decommissioning of the Rare Earths Facility, West Chicago, Illinois (draft supplement to the final environmental impact statement of June 1983).** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards). Jun 1987. 491p. (NUREG—0904-Suppl.1). Cambridge Scientific Abstracts, 5161 River Rd., Bethesda, MD 20816.

EPA No. 870223DS; NRC.

Decommissioning of the Rare Earths Facility, a nuclear facility in West Chicago, Cook County, Illinois, is proposed. The site, which contains three contiguous parcels, is owned by the Kerr-McGee Chemical Corporation. The eight-acre factory parcel was used for manufacturing operations, offices, and the utility supply system. The 27-acre disposal and storage parcel was used for disposal and storage of ore residues, sludges, and liquids from the factory. The eight-acre intermediate parcel lies between the other two parcels and was purchased to provide unrestricted access between the parcels. As a result of years of operation involving radioactive materials, the equipment and buildings on the site have become contaminated with thorium, and the disposal site contains relatively large quantities of residual materials. The preferred decommissioning plan would involve licensed storage of contaminated waste on the storage parcel for at least five years. Implementation of the project would allow for safe interim disposal of contaminated material at the site and safe use of two of the three parcels. Removal of the unsightly structures at the site would improve the appearance of the area. Decommissioning activities would increase fugitive dust emissions from the site, resulting in increases in radioactive and nonradioactive air pollution in off-site areas. Radon would continue to be released into the surrounding area of Chicago for a relatively long period.

29448 **(EIS—87-0242(Final)) Decontamination and disposal of radioactive wastes resulting from the March 28, 1979 accident, Three-Mile Island Nuclear Station, Unit 2, Pennsylvania-Docket No. 50-320 (final supplement 2 to the final environmental impact statement of March 1981).** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Jun 1987. 356p. (NUREG—0683). Cambridge Scientific Abstracts, 5161 River Rd., Bethesda, MD 20816.

EPA No. 870249FS; NRC.

Implementation of actions necessary for decontamination of the facility, defueling of the reactor, and disposition of the radioactive wastes that resulted from the accident on March 28, 1979 at Unit 2 of the Three-Mile Island Nuclear Station in Dauphin County, Pennsylvania are discussed. This second final supplement to the final environmental impact statement, filed in March 1981 on facility decontamination, reevaluates the environmental impacts of accident-generated water disposal alternatives, using more complete and current information. This supplement also includes a specific evaluation of the recently submitted proposal for water disposition. The project would alleviate a radiological hazard that threatens the well-being of the surrounding population and downstream communities. Risks to the general public have been estimated to be very small fractions of the estimated normal incidence of cancer fatalities and genetic disorders. The most significant potential impact is the risk of physical injury associated with transportation accidents. Social impacts during the operation could result in reduced property values, competition between the work force and tourists for temporary housing, and congestion of local traffic arteries. Some psychological stress would experienced by area residents. Economic effects could include increased electricity rates, reduced tourism, and possible resistance to consumption of area goods that consumers might mistakenly think are contaminated.

29449 **Biomass energy and soil erosion: assessment of resource costs.** Pimentel, D.; Krummel, J. (Oak Ridge National Lab., TN (USA)). *Biomass;* **14**: No. 1, 15-38(1987).

Erosion rates for stover, herbaceous, and woody biomass production systems are compared for different land types and management technologies. Ecological, energetic, and cost accounting measurements are used to quantify interactions between production systems and soil erosion factors. Harvesting agricultural crops for biomass energy accelerates already high erosion rates, while properly managed herbaceous production systems limit soil loss and might be appropriate for land areas with moderate relief. By translating these physical and biological variables to dollar values, via cost accounting, it is shown that soil erosion factors should be included in benefit/cost calculations.

55 BIOMEDICAL SCIENCES, BASIC STUDIES

5501 Behavioral Biology

REFER ALSO TO CITATION(S) 28837

5502 Biochemistry

REFER ALSO TO CITATION(S) 29320, 29466, 29467, 29473, 29524, 29528, 29529, 29531, 29532, 29534, 29539, 29540, 29545, 29546, 29550, 29551, 29562

29450 (DOE/ER—0343, pp 22-24) **Determination of adducts of polycyclic aromatic hydrocarbons to DNA.** Bean, R.M.; Chess, E.K.; Thomas, B.L.; Mann, D.B.; Dankovic, D.A.; Franz, J.A.; Springer, D.L. (Pacific Northwest Lab., Richland, WA (USA)). 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.).

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

Adducts to deoxyribonucleic acid (DNA), formed from metabolites of polynuclear aromatic compounds, are relatively persistent and correlate with bioresponse (carcinogenicity). Therefore, qualitative and quantitative analysis of adducts in the DNA of individuals may provide valuable information as to recent exposure to carcinogenic hydrocarbons. Further, the ability to detect adducts in a large segment of a population may have significant epidemiological significance. The current thrust of the analytical development at PNL is to isolate the DNA, liberate the adducted hydrocarbon residue from the DNA with acid hydrolysis, and prepare derivatives of the hydrolyzed species that will enhance its detection, quantitation, and characterization using gas chromatography/mass spectrometry (GC/MS). They have initiated the development of the necessary techniques using benzo[a]pyrene (B[a]P). Samples of DNA adducts of radiolabeled B[a]P have been prepared for study by reacting DNA isolated from calf thymus with benzo[a]pyrene-7,8-diol-9,10-epoxide (the ultimate carcinogenic form of B[a]P). Other DNA/B[a]P samples have been prepared by painting the skin of mice with radiolabeled B[a]P. The ability to prepare research quantities of adducts using the hepatocyte preparation method reported by Dankovic et al is a significant development to their DNA adduct analysis program.

29451 (DOE/ER—0343, pp 76-77) **Studies of the contribution of respiratory tract metabolism to the toxicity of inhaled chemicals.** Dahl, A.R.; Petridou-Fischer, J.; Sabourin, P.J.; Whaley, S.; Bond, J.A. (Lovelace Inhalation Toxicology Research Institute, Albuquerque, NM (USA)). 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.). Contract AC04-76EV01013.

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

Efforts to identify specific nasal enzymes are reported. The nasal enzymes identified and characterized within this project include the cytochromes P-450, primary xenobiotic metabolizing enzymes for PAH's, nitrosamines, some halogenated compounds, alkenes, alkanes, and a large variety of other organic compounds. In addition, flavin containing monooxygenase (FMO), has been identified in the nasal cavity and characterized. Carboxylesterases, and rhodanese have also been found in the nasal cavity. Other nasal enzymes identified include: catechol methyltransferases, phenol methyltransferases, epoxide hydrolase and glutathione and glucuronyl transferases. Each of these enzyme systems may have important toxicological effects on inhaled materials. The authors have tested the ability of nasal enzymes to metabolize substrates in vivo. In these experiments, radiolabeled substances were placed on the nasal mucosas of monkeys, dogs, or Syrian hamsters. Mucus was then collected and analyzed for metabolites. It was found that benzo(a)pyrene and dihydrosafrole are both metabolized on the nasal surface following instillation by this method. Currently, experiments are planned to test the role of nasal enzymes in the fate of inhaled materials.

29452 (DOE/ER—0343, pp 87) **Prediction of DNA structure from sequence.** Broyde, S.; Hingerty, B.E.; Figueroa, S.; Hayden, T. (New York Univ., NY (USA)). 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.).

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

A build-up technique has been developed which predicts DNA structures from sequence using minimized semi-empirical potential energy calculations. In the first stage of the calculations a global search of the conformation space of all sixteen deoxydinucleoside monophosphates was made. This entailed 2000 trials for each of these dimeric DNA conformational building blocks. In the next stage the minimum energy dimer conformations below 5 kcal./mole are combined to form trimers of any chosen sequence. Larger single stranded polymers can be generated by further build-up. Duplexes are produced by combining the single strands. By this method canonical A, B and Z form duplex helices have been computed a priori for the double stranded trimer d(CpGpC) x d(GpCpG), as well as novel duplexes.

29453 (DOE/ER—0343, pp 89) **Structure of the tumorigenic guanine N-2 adduct with (+) anti BPDE from minimized potential energy calculations.** Hingerty, B.E.; Broyde, S. (Oak Ridge National Lab., TN (USA)). 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.). Contract AC05-84OR21400.

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

The authors have employed a rational search strategy to compute structures of the tumorigenic adduct of (+)-7β, -8α-dihydroxy-9α, 10α-epoxy-7,8,9,10-tetrahydrobenzo(a)pyrene [(+) anti BPDE] to a DNA duplex dodecamer. In previous work they had made a global search of the conformation space of the (+) anti BPDE adduct to the deoxydinucleoside monophosphate dCpdG. Both carcinogen-base stacked states and base-base stacked states of low energy were found. They have now incorporated these important forms into a duplex dodecamer in the B DNA conformation and have minimized the energy of the larger polymers. In these carcinogen modified duplexes, forms with carcinogen at the helix exterior are energetically preferred to those that place the carcinogen in an intercalated situation.

29454 (DOE/ER—0343, pp 107-111) **Metabolism and genotoxicity.** Felton, J.S. 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.).

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

The five studies reported in this session represent different aspects of metabolism, encompassing molecular regulation to environmental monitoring; all are attempting to answer important questions about metabolism, and ultimately, chemical toxicity.

29455 (DOE/ER—0343, pp 115-117) **Modulation of gene expression by polycyclic aromatic hydrocarbons and polyhalogenated aromatic hydrocarbons.** Hankinson, O.; Carramanzana, N.M.; Chu, F.F.; Nanthur, J.; Sander, F.C.; Watson, A.J. (Univ. of California, Los Angeles (USA)). 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.). Contract AC03-76SF00012.

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

Mutants of a mouse heptatoma cell line were isolated. The mutants were not inducible for P_1-450 and lacked aryl hydrocarbon hydroxylase (AHH) activity. The majority of the mutants were recessive and these mutants represented four distinct complementation groups, i.e., genes. Human DNA-derived AHH-positive transfectants have been isolated from representative mutants of each complementation group. A portion of the gene responsible for the receptor translocation process has been isolated. The dominant mutants synthesize a trans-acting repressor of P_1-450 on RNA transcription. Using the cloned rat P_1-450 gene in transient transfection experiments, the site of action has been mapped.

29456 (DOE/ER—0343, pp 118-120) **Modulation of gene expression by barbiturates: the cloning, functional expression and regulation of the gene encoding a catalytically self-sufficient cytochrome P-450 fatty acid monooxygenase induced by barbiturates in Bacillus megaterium.** Wen, L.P.; Fulco, A.J. (Univ. of California, Los Angeles (USA)). 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.). Contract AC03-76SF00012.

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

The mechanism of barbiturate-mediated induction of cytochrome P-450/sub BM-3/ was studied by inserting large putative regulatory sequences from the cloned gene upstream from a promoterless chloramphenicol acetyl-transferase (CAT) gene contained in a shuttle vector. It was found that a DNA fragment encoding the N-terminal 28 amino acids of the protein and encompassing 1.5 kb 5' to the N-terminal, when placed in the correct orientation upstream from the CAT gene, allows CAT induction by barbiturates. When the construct is introduced into E. coli, CAT activity is expressed at a high level constitutively but is not increased by barbiturate addition to the growth medium. However, when the construct is introduced into B. megaterium, there is a low but significant constitutive expression of CAT activity (relative to a control) but a high induction of CAT activity by barbiturates. The observed levels of induction by various barbiturates (2-thiobarbituric acid, phenobarbital, pentobarbital, secobarbital and methohexital) correlated very well with the previously determined potency of these barbiturates as inducers of cytochrome P-450/sub BM-3/.

29457 (DOE/ER—0343, pp 140-142) **Local immune responses in the lung and immune cells at risk to inhaled chemicals.** Bice, D.E.; Muggenburg, B.A. (Lovelace Inhalation Toxicology Research Institute, Albuquerque, NM (USA)). 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.). Contract AC04-76EV01013.

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

Reported studies with dogs and primates demonstrate that, following instillation of antigen into portions of the lungs, antibody-forming cells accumulate predominantly in the immunized portion of the lung. They also demonstrate the presence of memory cells that results in intense antibody responses after additional antigen challenges. Additional studies report the evaluation of the effects of inhaled pollutants on the immune function of lung-associated lymph nodes.

29458 (DOE/ER—0343, pp 159-162) **Modulation of gene expression by oncogenic retrovirus.** Hays, E.F.; Kitada, S.; Merrill, J. (Lab of Biomedical and Environmental Sciences, Los Angeles, CA (USA)). 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.).

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

This paper reports the effects of two peptide factors, leukemia-derived growth factor (LDGF) and interleukin 1 (IL-1) on the growth of murine lymphoma cells in vitro. Studies of the mechanism of action show that lymphoma cells can be driven to proliferation in two ways: LDGF resulting from an altered expression of a putative LDGF gene by an autocrine manner and by IL-1 produced by accessory cells in the thymus and acting on thymocytes as in paracrine factor. It was speculated that IL-1 may be making the cells produce more or be more responsive to LDGF.

29459 **Clinical applications of measurement of serum immunoreactive levels of erythropoietin.** Miller, M.E.; Chandra, M.; Garcia, J.F. (Div. of Hematologic Research, The Memorial Hospital, Pawtucket, RI 02860). pp v of Hematopoietic cellular proliferation: An international conference in honor of Eugene P. Cronkite. Bond, V.P.;Chandra, P.;Rai, K.R. New York, NY; New York Academy of Sciences (1985). (CONF-8310231—).

From International conference on hematopoietic cellular proliferation; Upton, NY, USA (6 Oct 1983).

The purification of erythropoietin (Ep) in 1977 enabled investigators to more clearly define the role of this hormone in erythropoiesis in man. Radioimmunoassays were rapidly developed. Undoubtedly differences between levels of immunoreactive and biologically active Ep will be found but the resolution of these discrepancies will expand our understanding of the erythron. Recently others described a monoclonal antibody against Ep. Because of this breakthrough, large quantities of pure hormone should soon be available to a larger number of investigators than currently have access to it. The major clinical use of this hormone will probably be in the treatment of the anemia of chronic renal disease. In the relatively few years since the radioimmunoassay (RIA) was developed, measurements of the levels of this hormone have been made in several disease states as well as in normal man. Most of the findings to date confirm the predictions that have been made over the years based on studies done using the rather crude bioassay for Ep. In the present study the authors shall review and expand on what is known about subjects with chronic lung and renal disease.

29460 **Yeast molecular biology recombinant DNA. Recent advances.** Esposito, M.S. Park Ridge, NJ; Noyes Publications (1984). 349p. Noyes Publications, Mill Road at Grand Ave., Park Ridge, NJ 07656.

Insights into recombinant DNA technology, as applied to yeast research, are described in this volume based on the First Berkeley Workshop on Recent Advances in Yeast Molecular Biology. The results of various genetic engineering techniques in recombinant DNA studies in yeast are detailed and discussed. The papers describe experimental approaches using the newest technologies of DNA transformations, molecular cloning, and DNA sequence analysis. These techniques are employed to gain new information regarding chromosomal structure, gene regulation, DNA recombination and repair, and cell type control.

29461 **Genetic coding theory: Alternative genetic codes.** Findley, G.L.; Findley, A.M. (Dept. of Chemistry, New York Univ., New York, NY 10003). pp v of First colloquium in biological sciences. Scott, W.N.;Strand, F.L. New York, NY; The New York Academy of Sciences (1984). (CONF-8311307—).

From 1. colloquium in biological sciences; New York, NY, USA (11 Nov 1983).

The symmetry characteristics of the genetic code, as evidenced by the regular pattern of codon degeneracies, may be formalized empirically within a group-theoretic framework. Such an analysis is capable of generalization to include consideration of "ambiguous" codon assignments. Indeed, the rapidly growing collection of alternative codings has expanded the traditional concept of genetic code universality. The generalized genetic code (GGC) serves to unify alternative codon/amino acid assignments within the standard genetic code (SGC) of cytoplasmic protein synthesis. The result is a redefinition of genetic code universality in a modified form.

29462 **Quantitative structural analysis of ribosomal RNAs by scanning transmission electron microscopy.** Oostergetel, G.T.; Hainfeld, J.F.; Wall, J.S.; Boublik, M. (Biology Dept., Brookhaven National Lab., Upton, NY 11973). pp v of First colloquium in biological sciences. Scott, W.N.;Strand, F.L. New York, NY; The New York Academy of Sciences (1984). (CONF-8311307—).

From 1. colloquium in biological sciences; New York, NY, USA (11 Nov 1983).

In order to understand the structural and functional roles of rRNAs in the eukaryotic ribosome, the authors first investigated the conformational behavior of 18S and 28S RNA isolated from in vitro cultivated cells of baby hamster kidneys (BHK). Similarity in composition and function implies that the eukaryotic rRNAs have a similar "hairpin"-type structure as prokaryotic 16S and 23S RNA. This structure consists of segments of double-stranded stems, single strands, and single-stranded loops. However, folding of the secondary structure in three-dimensional space has yet to be established.

29463 **Systematic approach to induce new enzyme activities in naturally occurring proteins.** Saraswathi, S.; Keyes, M.H. (Owens-Illinois, Inc., Toledo, OH (USA)). pp 198-203 of Polymeric materials science and engineering. Washington, DC; American Chemical Society (1984). Contract AC02-81ER12003.

A new method developed to induce new catalytic activity in naturally occurring proteins consists of perturbing the natural conformation of the starting host protein and adding the competitive inhibitor of the enzyme whose activity it is desired to mimic. The new conformation induced by inhibitor-binding is then preserved by crosslinking when the inhibitor is present in the reaction solution. Semisynthetic enzymes generated by this method have been designated as Biological Synthetic Catalysts or BIO-SYN-CAT. The preparation, partial purification, and some properties of BIO-SYN-CAT esterases are described herein. 17 references, 3 figures, 5 tables.

5503 Cytology

REFER ALSO TO CITATION(S) 29485, 29549, 29558, 29561

29464 (DOE/ER—0343, pp 143-146) **In vivo effects of transient neutrophil influx on nasal epithelial mucosubstances: quantitative histochemistry.** Harkema, J.R.; Hotchkiss, J.A.; Harmsen, A.G.; Henderson, R.F. (Lovelace Inhalation Toxicology Research Institute, Albuquerque, NM (USA)). 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.). Contract AC04-76EV01013.

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

The present study was designed to determine by quantitative histochemistry if an in vivo influx of neutrophils through the nasal mucosa would induce significant quantitative changes in the amount of stored mucosubstance in the nasal respiratory epithelium. The study was divided into two parts. The first part morphometrically characterized the temporal post-exposure (24 hour period) response of the rat nasal mucosa to a single intranasal instillation of endotoxin (E), a chemotoxinogen for neutrophils. The second part examined the direct effects of E and indirect effects of infiltrating neutrophils on nasal intraepithelial mucosubstances by preventing the neutrophilic influx into the E-exposed nasal mucosa of the rat. Results of this study indicate that neutrophilic infiltration provides a stimulus for increased mucous secretion from respiratory epithelium. A similar neutrophilic infiltration induced by an inhaled chemical irritant could be responsible in part for the characteristic hypersecretion of mucus in respiratory airways.

29465 (DOE/ER—0343, pp 147-149) **Pulmonary translocation of particles by phagocytic cells: mechanisms and species comparisons.** Snipes, M.B.; Bice, D.E.; Gillett, N.A.; Guilmette, R.A.; Harmsen, A.G.; Mueller, H.L.; Muggenburg, B.A. (Lovelace Inhalation Toxicology Research Institute, Albuquerque, NM (USA)). 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.). Contract AC04-76EV01013.

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

The mechanisms of clearance of inhaled particles from the respiratory tract of rats and dogs are described. Studies were conducted to define the roles of phagocytic cells in lung clearance and retention with emphasis on translocation of particles to the lung-associated lymph nodes. Results show that clearance of particles from lung alveoli to lymph nodes is by phagocytic cells. It was demonstrated that some particles are also cleared by the mucociliary escalator within the phagocytic cells.

29466 (DOE/ER—0343, pp 199-200) **New approaches to the study of differentiation and carcinogenesis.** Ts'o, P.O.P. (Johns Hopkins Univ., Baltimore, MD (USA)). 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.).

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

Cellular studies on in vitro senescence, in vitro transformation and in vitro differentiation are described, including the interrelationship among these systems and the factors which tend to effect these systems in a coordinated manner. The focal point of this study is the properties and function of stem cells/progenitor cells in aging, cancer and differentiation. While methods of studying point mutation or single base changes have been highly emphasized in the past, methods to study the methylation status of the entire genome or DNA rearrangement of unknown fragments of the genome remain to be developed. Some studies in this direction are proposed. Computer assisted microphotometry has been developed for use with monoclonal antibodies to measure DNA insults and expression of genes through measurement of the copy numbers of mRNA through nucleic acid hybridization. Furthermore, control of gene expression can be accomplished by the use of sequence-specific nonionic oligonucleotide analogs which can form specific duplexes with single stranded accessible target nucleic acids such as mRNA, thereby blocking the expression of a specific gene. Exam-

ples of the use of this approach to suppress the expression of viral genes are given.

5504 Genetics

REFER ALSO TO CITATION(S) 29454, 29460, 29537

29467 (DOE/ER—0343, pp 112-114) **Molecular markers during development.** Springer, D.L. (Pacific Northwest Labs., Richland, WA (USA)). 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.).

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

Molecular probes have been developed to isolate and characterize genes responsible for cytochrome P-450 dependent monooxygenase isozymes. Four families of genes have been identified and are usually classified according to their responsiveness to phenobarbital, 3-methylcholanthrene (and TCDD and PAH), pregnenolone and pituitary hormones. The phenobarbital and 3-MC gene families have been identified, sequenced and mapped, and molecular probes have been prepared to measure the cellular concentrations of the specific DNA responsible for coding for two phenobarbital inducible isozymes, P-450b and P-450e. The genes that respond to pituitary hormones have been characterized to a lesser extent, because their gene product are present at much lower concentrations; therefore the difficulty of obtaining purified isozymes was greatly increased. The authors propose a study of altered imprinting during fetal/neonatal development in an effort to better define the role of cytochrome P-450 dependent monooxygenase enzymes in tumor development. They will determine whether (1) exposure to xenobiotics, including energy derived PAH, alter normal imprinting patterns as well as the specific mRNA concentrations coding for these isozymes and (2) altered imprinting changes the susceptibility of animals toward tumor development as indicated by specific DNA adducts known to be associated with the appearance of tumors.

29468 (SERI/SP—231-3206, pp 209) **Patterns of genetic diversity in three genera of oil-producing microalgae.** Gallagher, J.C. (City College of New York, NY (USA)). Sep 1987. NTIS, PC A12/MF A01. Order Number DE88001111/JAW.

In FY 1987 Aquatic Species Program: Annual report.

Both gel electrophoresis and comparisons of the physiological traits were used on strains of Nannochloris spp. (Chlorophyceae) and Amphora coffaeformis (Bacillariophyceae) that were obtained from natural populations and from existing culture collections. Nannochloropsis spp. strains were examined using strains obtained from culture collections only. In all three organisms, genetic diversity was found to be extremely high compared to terrestrial plants. This was shown by both the physiological traits and the enzyme banding patterns. There were no apparent relationships among patterns of differentiation revealed by different traits nor by the type of environment from which clones were isolated. In general, strains obtained from existing culture collections showed greater diversity as a group than did strains freshly collected from natural populations. However, even stringently selective sampling protocols applied to natural populations yielded a variety of genetically different strains. This probably indicates that the total genetic diversity in the species examined was underestimated. The amount of genetic diversity shown by these organisms coupled with previously collected data on other microalgae demonstrates that species of microalgae have far greater intrinsic genetic diversity than do species of higher plants. These data indicate that classical breeding approaches to strain improvement will probably not be successful even in the Chlorophyceae. The best strategy for strain improvement will most likely be dependent on the development of novel recombinant DNA techniques.

29469 (SERI/SP—231-3206, pp 210-228) **Studies of the chloroplast genome of exsymbiotic and free-living Chlorella.** Meints, R.H. (Univ. of Nebraska, Lincoln (USA)). Sep 1987. NTIS, PC A12/MF A01. Order Number DE88001111/JAW.

In FY 1987 Aquatic Species Program: Annual report.

The goal of this project was to characterize the chloroplast genome of a model microalgal species and in doing so to determine whether these methods might serve as a diagnostic device for identification of specific Chlorella with capability of biofuel production. If this were so, such genomes would be extremely useful for determining relationships between groups of algae and might determine the strategy for selection of partners in cell hybrid fusions; the ultimate goal of this research being the establishment of a genetic system within this asexual group. It is generally considered that unless a reasonably close relationship exists between fused partners, that stability of the hybrid is limited. Isolated chloroplast and nuclear genomic DNA from their model exsymbiotic algae (two isolates) and from eleven free-living Chlorella have been analyzed for relationships. Maps of the genomes were produced for an exsymbiotic and a free-living strain. Based on the preliminary investigations it appears that algae can be easily grouped into specific classes based on their DNA restriction length polymorphisms. Exsymbiont Nla and Chlorella kessleri (UTEX-20) have been subjected to detailed analysis to determine their fine structural organization. While the study was by no means exhaustive, this preliminary investigation has convinced the authors that many or all algae could be analyzed in this manner and that substantial information about algal relationships might be derived. 28 references.

29470 **Environmental use of genetically engineered organisms: overview of ecological concerns.** Sharples, F.E. (Oak Ridge National Lab., TN (USA)). pp 285 of 194. National Meeting of American Chemical Society, Division of Environmental Chemistry. Washington, DC; American Chemical Society (1987). (CONF-870802—).

From 194. American Chemical Society national meeting; New Orleans, LA, USA (30 Aug 1987).

Environmental use of engineered organisms gives rise to several categories of ecological questions. Will the engineered genetic change modify environmentally relevant characteristics of the organism? What will be the consequences of adding a new species (or genotype) to an ecological community? Can added genes spread to other organisms, and what would be the consequences of spreading? The answers to these questions would provide a sound basis for risk assessment. There is, however, uncertainty about how to get such answers because of gaps in knowledge of ecology, microbial biology and ecology, and genetics.

29471 **Variation in the human lymphocyte sister chromatid exchange frequency as a function of time: results of daily and twice-weekly sampling.** Tucker, J.D.; Christensen, M.L.; Strout, C.L.; McGee, K.A.; Carrano, A.V. (Lawrence Livermore National Lab., CA). *Environmental Mutagenesis;* **10**: No. 1, 69-78(1987). Contract W-7405-ENG-48.

The variation in lymphocyte sister chromatid exchange (SCE) frequency was investigated in healthy nonsmokers who were not taking any medication. Two separate studies were undertaken. In the first, blood was drawn from four women twice a week for 8 weeks. These donors recorded the onset and termination of menstruation and times of illness. In the second study, blood was obtained from two women and two men for 5 consecutive days on two separate occasions initiated 14 days apart. Analysis of the mean SCE frequencies in each study indicated that significant temporal variation occurred in each donor, and that more variation occurred in the longer study. Some of the variation was found to be associated with the menstrual cycle. In the daily study, most of the variation appeared to be random, but occasional day-to-day changes occurred that were greater than those expected by chance. To determine how well a single SCE sample estimated the pooled mean for each donor in each study, the authors calculated the number of samples that encompassed that donor's pooled mean within 1 or more standard errors. For both studies, about 75% of the samples encompassed the pooled mean within 2 standard errors. An analysis of high-frequency cells (HFCs) was also undertaken. The results for each study indicate that the proportion of HFCs, compared with the use of Fisher's Exact test, is significantly more constant than the means, which were compared by using the t-test. These results coupled with our previous work suggest that HFC analysis may be the method of choice when analyzing data from human population studies.

29472 DNA repair mutants. Thompson, L.H. (Lawrence Livermore National Lab., Biomedical Sciences Div., Univ. of California, Livermore, CA). pp v of Molecular cell genetics. Gottesman, M.M. New York, NY; John Wiley and Sons Inc. (1985). Contract W-7405-ENG-48.

The studies discussed here show that DNA repair mutants of CHO and other rodent lines are proving valuable for a variety of applications, especially as one views these mutants as an adjunct to the study of repair and metabolism of DNA in human cells. Several of the hamster mutants described differ phenotypically from the cells obtained from the human repair syndromes. However, so far it is not known whether any of the mutants isolated in cultured rodent cells involves the same locus as one of the human genetic disorders such as xeroderma pigmentosum. Extensive complementation tests are needed to address this issue, which is experimentally difficult because of the many genetic complementation groups that have already been identified for XP and other syndromes. As the genetic relationships between the repair genes of hamster and human cells become better understood, the hamster mutants can be used as a powerful tool for isolating human repair genes. Several of the hamster and mouse mutant lines have clear-cut phenotypes that can be effectively selected against in complementation assays. These features allow one to introduce a human gene into a rodent genetic background by DNA transfection procedures. The use of established recombinant DNA techniques should then allow the retrieval and molecular cloning of the repair gene.

29473 Cell fusion and chromosome sorting. Shay, J.W.; Cram, L.S. (Univ. of Texas Health Science Center at Dallas, Dept. of Cell Biology, Dallas, TX). pp v of Molecular cell genetics. Gottesman, M.M. New York, NY; John Wiley and Sons Inc. (1985).

Adaptation to environmental change is believed to occur by either mutation or amplification of DNA or by the parasexual acquisition of new genetic material. Even though much is known about the role of mutation rates as the basis of variation in somatic cells, only recently have a variety of methodologies been developed for parasexually introducing genetic material into eukaryotic cells. The first part of this chapter describes some of the methods used for introducing new genetic information into animal cells, while the second part describes the use of the fluorescence-activated cell sorter for isolating specific genetic material for use in gene transfer experiments. The topics of DNA-mediated and vector-mediated gene transfer, are covered extensively in other chapters so these subjects are not covered here. Since Chinese hamster cells in general have a high plating efficiency, a short generation time, and a small and stable karyotype, they have proven to be a convenient model for investigations into such diverse topics as mutagenesis, gene transfer, genetic complementation, differentiation, and regulation of gene expression. Thus, many of the methodologies described in this chapter were often initially "worked out" using Chinese hamster cells.

5506 Medicine

REFER ALSO TO CITATION(S) 29515

29474 (CONF-8609383—) Proceedings of clinical SPECT [single photon emission computed tomography] symposium. (American Coll. of Nuclear Physicians, Washington, DC). Sep 1986. Contract FG05-86ER60482. 144p. (CONF-8609383—). NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88003984/JAW.

From Joint international symposium on SPECT in clinical practice; Washington, DC, USA (22 Sep 1986).

It has been five years since the last in-depth American College of Nuclear Physicians/Society of Nuclear Medicine Symposium on the subject of single photon emission computed tomography (SPECT) was held. Because this subject was nominated as the single most desired topic we have selected SPECT imaging as the basis for this year's program. The objectives of this symposium are to survey the progress of SPECT clinical applications that have taken place over the last five years and to provide practical and timely guidelines to users of SPECT so that this exciting imaging modality can be fully integrated into the evaluation of pathologic processes. The first half was devoted to a consideration of technical factors important in SPECT acquisition and the second half was devoted to those organ systems about which sufficient clinical SPECT imaging data are available. With respect to the technical aspect of the program we have selected the key areas which demand awareness and attention in order to make SPECT operational in clinical practice. These include selection of equipment, details of uniformity correction, utilization of phantoms for equipment acceptance and quality assurance, the major aspect of algorithms, an understanding of filtered back projection and appropriate choice of filters and an awareness of the most commonly generated artifacts and how to recognize them. With respect to the acquisition and interpretation of organ images, the faculty will present information on the major aspects of hepatic, brain, cardiac, skeletal, and immunologic imaging techniques. Individual papers are processed separately for the data base. (TEM)

29475 (DOE/ER/60295—3) [Investigations into the use of radiolabeled monoclonal antibodies for selective cell labeling in whole blood]. Thakur, M.L. (Thomas Jefferson Univ., Philadelphia, PA (USA)). 1987. Contract FG02-85ER60295. 83p.

Seventeen monoclonal antibodies (MAbs), 7 specific for human platelets and 10 specific for human polumorphonuclear leukocytes (PMNs) have been evaluated. One MAb has been identified as the antibody most suitable for canine platelets and another has been evaluted as the best among the group, for human neutrophil studies. Indium-111, Tc-99m, and I-125 have been used as the tracers. Six bifunctional chelating agents (BFCAs) were evaluated in order to determine the most efficient agent for maximal cell labeling efficiency. Among these, the DTPA has given us the best results. (4) To botain maximum In-111 chelation and minimum loss of the MAb affinity, the optimal BFCA to MAb ratios for both IgG and IgM type of MAbs were determined. Four different substances, stannous chloride, ascorbic acid, sodium dithionite and sodium borohydride, were evaluated as reducing agents for Tc-99m reduction and its optimal binding to MAbs. Dithionite at the concentration of 200 ug/ml DTPA-MAb solution provides greater than 50% Tc-99m labeling efficiency and maintains its immunospecificity equal to that of In-111-DTPA-MAb. The ability of radiolabeled MAb to interact with blood cells selectively in whole blood and with isolated blood cells was assessed and compared.

29476 (INIS-BR—988) Comparison of the clonidine test with the insulin tolerance test in the evaluation of patients with short stature. Batista, M.C. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). 1986. 158p. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88702572/JAW.

Thirty one patients aged 2.9 to 17.5 years, with heights from 1.3 to 85 standard deviations below the mean for age and sex, are studied. Two GH provocative tests are done: (1) insulin tolerance test (ITT): intravenous regular insulin 0.1 Ukg body weight; (2) clonidine test (CLOT): oral clonidine 0.0375 mgm^2 surface area. Serum GH is measured by a radioimmunoassay method developed in the laboratory and calibrated against a reference preparation provided by the National Institutes of Health. (M.A.C.).

29477 (INIS-mf—11655) Contribution to radiotherapy of the larger-celled bronchial carcinoma. Zoubie, I. (Marburg Univ. (Germany, F.R.). Fachbereich Humanmedizin). 28 May 1982. 103p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88753292/JAW.

This work consists of a retrospective definition of disease courses of 859 patients with lung tumors and the definition of the survival curves in their dependence on histology, radiation dose and sex. With 721 larger-celled bronchial carcinomas the ratio of men to women was 12:1. The age peak lay between 60 and 70 years. The one/five year survival rate of all included larger-celled bronchial carcinomas (n=701) was, independent from the therapy form, 35.7, resp. 4.78%. The one year/five year survival rates were for the squamous epithelia 31.08/0.58%, for the undifferentiated carcinomas 25.34/3.41%, and for the lung tumors without histology 35.4/5.14%. Lobectomized patients with squamous epithelium carcinoma had in comparison to pneumonectomized patients a clearly

higher survival chance. A clearly sex-dependent predisposition for a certain type of carcinoma was not present. (TRV).

29478 **(INIS-mf—11656) Quantitative measurement of duodeno-gastral reflux with /sup 99m/Tc-HIDA in the framework of stomach secretion analysis.** Hauke, U. (Muenchen Univ. (Germany, F.R.). Fakultaet fuer Medizin). 24 Jun 1982. 107p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88753293/JAW.

99m Tc HIDA was put into use first under standardized conditions in the framework of routinely carried out stomach secretion analyses in order to study the importance of bile reflux in stomach disorders. With this procedure a simple possibility is given in the area of stomach secretion analysis to test if there is a bile reflux to the stomach. Patients with fresh duodenal ulcers had significantly higher reflux rates than those with chronic Ulcus duodeni. After selective proximal vagotomy with submucal pyloro plastic the reflux rates sank in comparison to those before the operation. The color of the aspirate and the reflux values, measured by the here presented procedure, are directly correlated. (TRV).

29479 **(INIS-mf—11657) Problems with the preparation and evaluation of teleradiographs of the skull in the Norma frontalis with special consideration of the angular teleradiographic unit.** Arnold, J. (Muenchen Univ. (Germany, F.R.). Fakultaet fuer Medizin). 25 Nov 1982. 75p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753294/JAW.

With the help of the angular teleradiographic unit the possibility of simultaneous preparation of teleradiographs in the Norma frontalis and the Norma lateralis is studied. It was shown that the problem of scattered radiation, even with improved X-radiation techniques, cannot to desirable extents be mastered. The soft skull coverings have a deciding influence on the extent of the scattered radiation. By the use of the angular teleradiographic unit whose two radiation sources stand at right angles to another with a FFA of 150 cm each, the interval between frontal and lateral teleradiographs could be shortened. The individual movements of the patient could thereby be diminished and projection distortions between the two exposures reduced. A further advantage of the angular teleradiographic unit is that lateral and posterior-anterior exposures can be produced without changing the head positioning. The prerequisite is a stable cephalostat. For the evaluation of the posterior-anterior teleradiographic exposures of the facial bones a method is recommended, which is simple and comprehensive and satisfies the requirements of clinical diagnostic. Finally, a method for the clear representation of the sixth year molars is suggested in which the clinical crown is covered with a radiographically contrasting foil (tin foil).

29480 **(INIS-mf—11658) Do X-ray diagnosis and endoscopic findings agree in the case of Ulcus ventriculi and Ulcus duodeni?.** Kary, D. (Marburg Univ. (Germany, F.R.). Fachbereich Humanmedizin). 26 Feb 1982. 56p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753295/JAW.

The goal of this work is a correlation of the radiological and endoscopic findings of a university clinic in cases of stomach and duodenal ulcers. The sensitivity of the radiological examinations with Ulcus ventriculi, respectively duodeni, was 89%, respectively 91%; the specificity was 74%, respectively 85%. From these results suggestions were made for the use of endoscopy with radiologically diagnosed ulcers of the duodenum or stomach. Whereas the endoscopy is superior for the recognition of florid ulcers in a deformed Bulbus duodeni, radiology is superior in determining sinus developments, stenotic areas and the extent of an evacuation disturbance. A proper diagnosis is made possible by a purposeful combination of radiological and endoscopic-bioptic methods. (TRV).

29481 **(INIS-mf—11659) Value of the hepatobiliaric function scintigraphy with Tc-99m-DAIDA for post-operative biliary tract function diagnosis.** Ast, G. (Marburg Univ. (Germany, F.R.). Fachbereich Humanmedizin). 1 Jul 1982. 92p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753296/JAW.

The goal of this work was the examination of the value of biliary tract scintigraphy with 99m Tc DAIDA for post-operative supervision after biliary tract operations. The subjects were made up of 22 patients, who between 1969 and 1980 had undergone a choledochus revision with the insertion of a T drainage. In all cases with cholestase-specific laboratory findings the intra- and extrahepatic biliary tracts were expanded and in 71% of the cases were combined with an organically dependent drainage retardation which was scintigraphically proven. The proof of an organically dependent drainage retardation in scintigraphy coincided almost always with expanded biliary paths and in almost half the cases with blockage-specific changes in the laboratory values. Conclusion: By patients with operations on the biliary tracts the indication for biliary tract scintigraphy with 99m Tc DAIDA is always given, if with cholestase- oder liver-specifically changed laboratory values no concretions using sonography or preliminary radiographs could be proven. (TRV).

29482 **(INIS-mf—11660) Results of radioiodine therapy of benign thyroid disease.** Pronath, A. (Technische Univ. Muenchen (Germany, F.R.). Fakultaet fuer Medizin). 14 May 1982. 172p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88753297/JAW.

The goal of this work is the quantification of therapy results of a radioiodine therapy with Iodine 131 on 367 patients with the following benign thyroid diseases: euthyroidal struma, hyperthyroidism, hyperthyroidal struma and autonomous adenoma. 1. Euthyroidal struma - subjective improvement and objective diminution of the struma by 63%, subjective or objective improvement by 21% of the patients. Including the probable successful therapies the success rate was all together 90.1%. 2. Hyperthyroidism - after one-time/more-time (18.6%) radioiodine therapy the success rate was 71.5/85.7% including latent (8.6/10.0%) and manifest (7.1/8.5%) hypothroidism. 3. Hyperthyroidal struma - after one-time/more-time (16.9%) radioiodine therapy the success rate was 74.7/90.1% including latent (-/5.7%) and manifest (1.4/2.8%) hypothyroidism. 4. Autonomous adenoma - after one-time/two-time (5.2%) radioiodine therapy the success rate was 80.5/84.6% including 15.5% latent hypothyroidism. The results will be discussed in comparison to published data and to operation and thyrostatic treatment. (TRV).

29483 **(PB—88-162235/XAB) Health-hazard evaluation report GHETA 83-309-1405, Chrysler Corporation Foundry, Indianapolis, Indiana.** Patil, A. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Jan 1984. 15p. (GHETA—83-309-1405). NTIS, PC A03/MF A01.

In response to a request arising out of employee concerns over the medical surveillance program at the Chrysler Corporation Foundry located in Indianapolis, Indiana, an evaluation was made of chest radiographs evaluated by the program with specific concern directed to disagreement on the radiographic diagnosis of pneumoconiosis. The request was made by the Chrysler Corporation and the United Auto Workers National Joint Committee on Health and Safety. Three NIOSH certified B-readers independently interpreted a set of 78 systematically sampled posteroanterior (PA) chest radiographs from the system files. These interpretations were compared among themselves and with company interpretations. While none of the radiographs was deemed unreadable, 35% were classified as having poor technical quality. Only one film was found which had a profusion of small opacities, and the company had interpreted the film as positive. Overall, agreement on proportion of positive readings and agreement on individual films was as good between the company and B-readers as it was between any two of the individual B-readers. The author recommends, however, that in order to avoid future complaints of the nature, the company should use standard radiographic equipment and techniques, NIOSH certified B-readers, and current international classifications of radiographs for pneumoconioses in their medical surveillance program.

5507 Microbiology

REFER ALSO TO CITATION(S) 28800, 28938, 28939, 28940, 28941, 28942, 28943, 28944, 28945, 28946, 28947, 28948, 28949, 28950, 28951, 28960, 29468, 29469

29484 (SERI/SP—231-3206, pp 155) Environmental effects on photorespiration in the diatom Chaetoceros muelleri. Cohen, R.R.H. (Colorado School of Mines, Golden (USA)). Sep 1987. NTIS, PC A12/MF A01. Order Number DE88001111/JAW.

In FY 1987 Aquatic Species Program: Annual report.

Conditions of high solar irradiance, pH, dissolved oxygen (D.O.), and salinity and low CO_2 anticipated during the growth of algae as a biofuel source may induce photorespiratory losses in phytoplankton. Algae have been screened for high specific growth rates under these conditions, with net production the primary concern. However, modifying conditions conducive to respiratory losses may result in even higher net production. Experiments were performed to identify photorespiration in Chaetoceros muelleri, an algae that has very high growth rates at high salinities and high pH, and to examine the effects of pH, salinity, temperature, light and D.O. on the magnitude of photorespiration. Respiration and photorespiration were determined by simultaneously measuring apparent photosynthesis (pH drift) and true photosynthesis (^{14}C 6 minute incubations), by dark D.O. transients and by DCMU metabolic poison. Photorespiration increased dramatically with pH and D.O. as expected. Photorespiration was 50% higher at 70,000 umhos/cm than at 23,000 umhos/cm conductivity. Photorespiration was highest at highest light intensity (300 uE/m^2/s) but photosynthesis increased faster than photorespiration at increasing light intensity. Thus, net production was still highest at highest light. Chaetoceros mueller, photorespiration did not vary significant from 20 to 34 B. DCMU poisoned samples yielded values close to dark respiration measurements, suggesting that DCMU inhibits both photosynthesis and photorespiration but not dark respiration in the light.

5509 Pathology

REFER ALSO TO CITATION(S) 29555

29485 Studies in chronic lymphocytic leukemia: Blood lymphocyte surface characteristics and immunologic functional status of patients and correlation with clinical stage. Rai, K.R.; Cronkite, E.P.; Sawitsky, A.; Chandra, P.; Steinberg, J. (Div. of Hematology/Oncology, Long Island Jewish-Hillside Medical Center, New Hyde Park, NY 11042). pp v of Hematopoietic cellular proliferation: An international conference in honor of Eugene P. Cronkite. Bond, V.P.; Chandra, P.; Rai, K.R. New York, NY; New York Academy of Sciences (1985). (CONF-8310231—).

From International conference on hematopoietic cellular proliferation; Upton, NY, USA (6 Oct 1983).

Because of the observations of others, the authors were able to propose the following criteria for clinical staging of CLL: Stage O: Lymphocytosis only (blood -- 5000 lymphocytesmm^3 and marrow -- 40%). Stage I: Lymphocytosis + enlarged nodes. Stage II: Lymphocytosis + enlarged spleen andor liver (with or without enlarged nodes). Stage III: Lymphocytosis + anemia (< 11 g% hemoglobin), with or without enlarged nodes, spleen, and liver. Stage IV: Lymphocytosis + thrombocytopenia (< 100,000 plateletsmm^3), with or without anemia and enlarged nodes, spleen, and liver. Others demonstrated that this method of clinical staging was a reliable index of prognosis. The authors demonstrated that there was a correlation between clinical stage and total body cell mass.

5510 Physiological Systems

REFER ALSO TO CITATION(S) 29280, 29811

5520 Public Health

REFER ALSO TO CITATION(S) 29483

29486 (PB—88-163795/XAB) Truck transportation of hazardous materials: a national overview. Final report, October 1983-October 1986. Maio, D.J.; Liu, T.K. (Department of Transportation, Cambridge, MA (USA). Transportation Systems Center). Dec 1987. 166p. (DOT-TSC-RSPA—87-8). NTIS, PC A08/MF A01.

The primary objective of the effort has been to provide government regulators and policymakers with (a) an estimate of the aggregate national volume of hazardous chemical and petroleum products transportation in trucks, (b) a profile of the truck fleet involved in hazardous-materials transport, and (c) the geographical distribution of the transport activity. After defining data sources and methods, hazardous chemical and petroleum products transport is quantified in terms of total tons, ton-miles, and haul distances. Truck-transport categories include domestic production from U.S. plants, imports from ports of entry, and distribution from regional storage facilities. Next, the report characterizes the truck fleet involved in hazardous-materials transport in terms of truck size, type, and placarded operations. Geographical distribution of truck transport of hazardous materials is then presented graphically, with traffic patterns mapped in terms of major highway corridors. Finally, trends in truck transport of hazardous chemical and petroleum products since 1977 are analyzed.

5530 Agriculture And Food Technology

29487 (INIS-BR—989) Thyroid anatomy and topography of toad (Bufo marinus ictericus). Autoradiography and histologic study. Santos, O.R. dos. (Sao Paulo Univ. (Brazil). Inst. de Biociencias). 1970. 69p. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88702573/JAW.

The autoradiographic method is used for the study of the toad's thyroid of Bufo marinus ictericus by ^{131}I. Histolological proceedings are done. Comparative evaluations with bibliographic informations are presented. (M.A.C.).

29488 (INIS-BR—1001) Utilization of radioisotopes in the agriculture. Cerri, C.C. (Centro de Energia Nuclear na Agricultura, Piracicaba (Brazil)). 1987. 18p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702585/JAW.

Some aspects of radioisotopes utilization in the agriculture, such as, the use of gamma radiation for genetic improvement of plants; the use of C^{14} as tracer for comprehension of the vegetable physiology; the use of nitrogen and phosphorus isotopes in soil fertilization and plant nutrition; the use of radiation for inset sterelization and, measurement of the humidity and density of soils by neutron moderation and attenuation of gamma radiation, are presented. (M.C.K.).

29489 (INIS-BR—1012) Application of radioisotopes in engineering and industry. Rozental, J. de J. (Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro). 1987. 30p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702596/JAW.

The potential of radioisotope utilization in the health, engineering, industry and agriculture fields, is presented. (M.C.K.).

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

5601 Radiation Effects

REFER ALSO TO CITATION(S) 29543

29490 (DOE/ER/60402—1, pp 12-18) **Model-free approach to the estimation of radiation hazards. I. Theory.** Zaider, M.; Brenner, D.J. Jul 1986. NTIS, PC A05/MF A01. Order Number DE86013991/JAW.

In Radiation physics, biophysics, and radiation biology. Progress report, December 1, 1985-November 30, 1986.

The experience of the Japanese atomic bomb survivors constitutes to date the major data base for evaluating the effects of low doses of ionizing radiation on human populations. Although numerous analyses have been performed and published concerning this experience, it is clear that no consensus has emerged as to the conclusions that may be drawn to assist in setting realistic radiation protection guidelines. In part this is an inherent consequences of the rather limited amount of data available. In this paper the authors address an equally important problem; namely, the use of arbitrary parametric risk models which have little theoretical foundation, yet almost totally determine the final conclusions drawn. They propose the use of a model-free approach to the estimation of radiation hazards.

29491 (DOE/ER/60402—1, pp 19-22) **Model-free approach to the estimation of radiation hazards. II. Dosimetry for Japanese atomic bomb survivors.** Brenner, D.J.; Zaider, M. Jul 1986. NTIS, PC A05/MF A01. Order Number DE86013991/JAW.

In Radiation physics, biophysics, and radiation biology. Progress report, December 1, 1985-November 30, 1986.

In the first paper in this series, a non-parametric formalism is presented for interpolating the cumulative hazard function H, as a function of time (t), neutron dose (D/sub n/), and gamma dose (D/sub γ/) from estimated values at particular points (t, D/sub n/, D/sub γ/) in space. In this paper, the authors discuss the dosimetry that is used for the estimation of leukemia mortality among Japanese Atomic Bomb survivors as a function of (t, D/sub n/, D/sub γ/).

29492 (DOE/ER/60402—1, pp 23-28) **Model-free approach to the estimation of radiation hazards. III. Application to leukemia mortality among Japanese atomic bomb survivors.** Zaider, M.; Brenner, D.J. Jul 1986. NTIS, PC A05/MF A01. Order Number DE86013991/JAW.

In Radiation physics, biophysics, and radiation biology. Progress report, December 1, 1985-November 30, 1986.

In the companion paper to this, a non-parametric formalism is presented for interpolating the cumulative hazard function H, as a function of time (t), neutron dose (D/sub n/), and gamma dose (D/sub γ/) from estimated values at particular points in (t, D/sub n/, D/sub γ/) space. In the second paper values of the variables D/sub n/ and D/sub γ/ were estimated at Hiroshima and Nagasaki using revised dosimetry. In this note, the authors give an example of the use of the formalism by estimating leukemia mortality as a function of (t, D/sub n/, D/sub γ/). Bias-free predictions may thus be made of the hazard rates at different times after irradiation by low doses of neutrons and gamma rays, either singly or in combination.

29493 (DOE/ER/60402—1, pp 49-56) **Radiological Research Accelerator Facility.** Goldhagen, P.; Marino, S.A.; Randers-Pehrson, G.; Hall, E.J. Jul 1986. NTIS, PC A05/MF A01. Order Number DE86013991/JAW.

In Radiation physics, biophysics, and radiation biology. Progress report, December 1, 1985-November 30, 1986.

The Radiological Research Accelerator Facility (RARAF) is based on a 4-MV Van de Graaff accelerator, which can be used to generate a variety of well-characterized radiation beams for research in radiobiology and radiological physics. It is part of the Radiological Research Laboratory (RRL), and its operation is supported as a National Facility by the US Department of Energy. RARAF is available to all potential users on an equal basis, with priorities based on the recommendations of a Scientific Advisory Committee. Facilities and services are provided to users, but the research projects themselves must be supported separately. This chapter presents a brief description of current experiments being carried out at RARAF and of the operation of the Facility from January through June, 1986. Operation of the Facility for all of 1985 was described in the 1985 Progress Report for RARAF. The experiments described here were supported by various Grants and Contracts from NIH and DOE and by the Statens Stralskyddsinstitut of Sweden.

29494 (DOE/ER/60402—1, pp 58-61) **Effect of ionizing radiation on DNA-mediated gene transfer efficiency.** Rubin, J.S.; Hall, E.J.; Hei, T.K. Jul 1986. NTIS, PC A05/MF A01. Order Number DE86013991/JAW.

In Radiation physics, biophysics, and radiation biology. Progress report, December 1, 1985-November 30, 1986.

Ionizing radiation causes a number of molecular changes in cells including DNA damage and gene amplification. In this study the authors examined whether radiation can effect the efficiency of integration and expression of exogenous DNA sequences. They examined both ^{137}Cs γ rays and various monoenergetic neutron beams. This enabled them to test whether the LET or RBE of the radiation had any effect. Rat2 cells were transfected with various amounts of the bacterial plasmid pSV2-GPT along with carrier DNA for 24 hours.

29495 (DOE/ER/60402—1, pp 62-63) **High-LET and low-LET sublethal damage.** Bird, R.P.; Marino, S.A. Jul 1986. NTIS, PC A05/MF A01. Order Number DE86013991/JAW.

In Radiation physics, biophysics, and radiation biology. Progress report, December 1, 1985-November 30, 1986.

Track segment irradiations at RARAF previously included studies of the combined effect of two different radiations when doses were given with only a few minutes separation. The results showed that sublethal damage from high-LET and low-LET radiations interacted to contribute to lethality. This work is being extended to include greater times between doses of the two radiations. The more common technique of splitting doses of the same radiation also will be in this study of sublethal damage and its repair. A common conclusion from experiments in the past was that split doses of high-LET radiation showed little or no repair of sublethal damage. However, such experiments often used doses of high-LET radiation with which sublethal damage would be minimal, according to the theory of dual radiation action. The current experiments use the track segment facility at RARAF for irradiating monolayers of cells with charged particles and with x rays from the 50 kV x-ray generator.

29496 (DOE/ER/60402—1, pp 64-66) **Nuclear size and cell division delay.** Bird, R.P. Jul 1986. NTIS, PC A05/MF A01. Order Number DE86013991/JAW.

In Radiation physics, biophysics, and radiation biology. Progress report, December 1, 1985-November 30, 1986.

Radiation-induced division delay has been linked to damage at the nuclear envelope. Further, cells in G_2 phase are drastically arrested by high LET radiation such that single particles traversing cell nuclei may produce measurable division delay. A modest effort was initiated using two related cell lines of different size, near-diploid cells and near-tetraploid cells of Chinese hamster origin, to compare their sensitivity for radiation-induced division delay. If the nuclear surface is the critical target, then a larger nuclear cross-section presented to an alpha-particle beam should exhibit delay induced by a lesser particle fluence. Preliminary estimates of the extent of delay in asynchronous cultures following low doses of gamma-irradiation or of alpha-irradiation were made by in-situ observation of the time of onset of mitosis and by fixation and staining of cultures to determine the mitotic index as a function of time after irradiation. The basic approach to evaluating division delay will be to use Colecemid to accumulate mitotic cells over a period of time.

29497 (DOE/ER/60402—1, pp 67-69) **LET effects on normal and radiosensitive cell lines.** Geard, C.R.; Travisano, M. Jul 1986. NTIS, PC A05/MF A01. Order Number DE86013991/JAW.

In Radiation physics, biophysics, and radiation biology. Progress report, December 1, 1985-November 30, 1986.

Charged particles in the track segment mode were produced by the RARAF Van de Graaff accelerator and used to irradiate two CHO cell lines, a radiosensitive hypermutable line EM9 and its normal parent AA8. Asynchronous cells were irradiated attached to 6 micrometer thick Mylar with protons, deuterons and helium-3 particles at LETs ranging from 10 to 150 keV per micrometer. A 50 kVp x-ray tube integrated into the track segment facility provided a low LET comparison. Following irradiation cells were monitored for clonogenicity, and in a separate series of experiments frequencies of sister chromatid exchanges. Up to 9 experiments were carried out at each LET, with a total of 8 radiations of different LETs being compared. The optimally effective LET for cell survival was between 80 and 120 keV per micrometer, with the 150 keV per micrometer particles indicating energy wastage. The differential between the normal and radiosensitive cell lines was maintained at all LETs.

29498 (DOE/ER/60402—1, pp 70-73) **Dose fractionation effects of low-dose neutron exposure to C_3H 10T1/2 cells.** Miller, R.C.; Komatsu, K.; Marino, S.A.; Hall, E.J. Jul 1986. NTIS, PC A05/MF A01. Order Number DE86013991/JAW.

In Radiation physics, biophysics, and radiation biology. Progress report, December 1, 1985-November 30, 1986.

Oncogenic transformation of mammalian cells in culture by ionizing radiation has become a useful tool in evaluating induction as a function of radiation quality, dose rate, and dose fractionation. Previous results indicate that whereby fission-spectrum neutrons delivered at low dose rates or in a five-fraction protocol stretched over four days increased the transformation frequency of exposed C_3H 10T1/2 cells compared to single-dose treatments administered at a high dose rate. The authors approach to the question of dose fractionation effects with neutrons is to expose cells to fractionated doses of monoenergetic neutrons that range in energy from 0.22 to 14 MeV. By this protocol, they are able to determine the carcinogenic potential of exposures as a function of neutron energy.

29499 (DOE/OR/00033—T398) **Calibration of thermoluminescent dosimeters to xenon-133 for both submersion and non-submersion geometries.** Marcinowski, F. III. (Michigan Univ., Ann Arbor (USA). Dept. of Environmental and Industrial Health; Oak Ridge Associated Universities, Inc., TN (USA)). Apr 1987. Contract AC05-76OR00033. 89p.

Thesis.

This work developed calibration factors for a two element dosimeter that was exposed to several geometries of xenon-133. The three geometries examined were an infinite overhead xenon-133 plume greater than 80 cm above the dosimeter, a dosimeter submersed in an infinite cloud of xenon-133;and a dosimeter exposed to a xenon-133 cloud in a 91 cm calibration chamber. 17 refs., 2 figs., 47 tabs.

29500 (HW—81010, pp 6-37) **Dosimetry investigations of the recuplex criticality accident.** Gamertsfelder, C.C.; Larson, H.V.; Nielsen, J.M.; Roesch, W.C.; Watson, E.C. 7 Apr 1962. NTIS, PC A 05. Order Number DE88002340/JAW.

In Accidental nuclear excursion recuplex operation 234-5 facility: Final medical report.

Three individuals exposed to body doses of mixed neutron and gamma radiation ranging from 19 to 123 rems were observed following a criticality accident in a plutonium waste chemical recovery facility at the Hanford Atomic Products Operation. This report describes the accident and summarizes the results of exposure information obtained from personnel dosimeters for the gamma rays and from whole body counts and blood activation analyses for the neutrons. 31 references, 8 figures, 7 tables.

29501 (HW—81010, pp 38-41) **Clinical notes.** Fuqua, P.A. 7 Apr 1962. NTIS, PC A 05. Order Number DE88002340/JAW.

In Accidental nuclear excursion recuplex operation 234-5 facility: Final medical report.

Three individuals exposed to body doses of mixed neutron and gamma radiation ranging from 19 to 123 rems were observed following a criticality accident in a plutonium waste chemical recovery facility at the Hanford Atomic Products Operation. This report summarizes medical observations and decisions concerning clinical tests and work restrictions made over a period of approximately fifteen months.

29502 (HW—81010, pp 42) **Ophthalmological examination summary.** Davis, L.L. 7 Apr 1962. NTIS, PC A 05. Order Number DE88002340/JAW.

In Accidental nuclear excursion recuplex operation 234-5 facility: Final medical report.

Three individuals exposed to body doses of mixed neutron and gamma radiation ranging from 19 to 123 rems were observed following a criticality accident in a plutonium waste chemical recovery facility at the Hanford Atomic Products Operation. This report summarizes the results of opthalmological examinations and indicates that there have been no changes in the lenses of these employees. The lenses will be carefully examined on a routine basis in the future.

29503 (HW—81010, pp 43-50) **Blood counts and blood chemistry.** Marks, S.; Ritter, B.C. (Kadlec Methodist Hospital, Richland, WA (USA)). 7 Apr 1962. NTIS, PC A 05. Order Number DE88002340/JAW.

In Accidental nuclear excursion recuplex operation 234-5 facility: Final medical report.

Three individuals exposed to body doses of mixed neutron and gamma radiation ranging from 19 to 123 rems were observed following a criticality accident in a plutonium waste chemical recovery facility at the Hanford Atomic Products Operation. A study of blood counts over a period of many months following the accident failed to show any significant abnormalities except for a slight drop in the absolute lymphocyte count immediately following the accident in one individual.

29504 (HW—81010, pp 51-54) **Bone marrow.** Andrews, G.A.; Kniseley, R.M. (Oak Ridge Institute of Nuclear Studies, TN (USA)). 7 Apr 1962. NTIS, PC A 05. Order Number DE88002340/JAW.

In Accidental nuclear excursion recuplex operation 234-5 facility: Final medical report.

Three individuals exposed to body doses of mixed neutron and gamma radiation ranging from 19 to 123 rems were observed following a criticality accident in a plutonium waste chemical recovery facility at the Hanford Atomic Products Operation. This report summarizes results of histological sections and smears of bone marrow taken 1, 7, 16 and 30 days after the accident. Minor changes were found in two of the three individuals.

29505 (HW—81010, pp 55-56) **Reports of bone marrow aspirations.** Kramer, R.J. 7 Apr 1962. NTIS, PC A 05. Order Number DE88002340/JAW.

In Accidental nuclear excursion recuplex operation 234-5 facility: Final medical report.

Three individuals exposed to body doses of mixed neutron and gamma radiation ranging from 19 to 123 rems were observed following a criticality accident in a plutonium waste chemical recovery facility at the Hanford Atomic Products Operation. Results of four sternal bone marrow aspirations are presented for each exposed employee. Samples were obtained during the month immediately following the accident.

29506 (HW—81010, pp 57-69) **Morphologically aberrant blood cells in Hanford accident casualties.** Ingram, M.L. (Univ. of Rochester, NY (USA)). 7 Apr 1962. NTIS, PC A 05. Order Number DE88002340/JAW.

In Accidental nuclear excursion recuplex operation 234-5 facility: Final medical report.

Three individuals exposed to body doses of mixed neutron and gamma radiation ranging from 19 to 123 rems were observed following a criticality accident in a plutonium waste chemical recovery facility at the Hanford Atomic Products Operation. This

report summarizes results of cytological tests for morphologically aberrant blood cells. The major types of aberrant cells found in the accident victims were as follows: binucleate lymphocytes; lymphocytes with nuclear fragments; monocytosis; immature monocytes; giant hypersegmented granulocytes; granulogytes with shaggy chromatin structure; plasma cells; plasmacytoid early mononuclear cells; binucleate monocytes and monocytes with nuclear fragments; blasts, mitotic cells and other cells; nucleated red cells; and giant platelets. Aberrant forms were most numerous during the first two weeks after exposure. The magnitude of the changes observed when compared with changes observed in Y-12 and Lockport casualties is seen to correspond most closely to the low-dose Lockport casualties. 9 references, 4 figures, 3 tables.

29507 (HW—81010, pp 70-77) **Analysis of leukocyte chromosome aberrations - preliminary report.** Bender, M.A.; Gooch, P.C. (Oak Ridge National Lab., TN (USA)). 7 Apr 1962. NTIS, PC A 05. Order Number DE88002340/JAW.

In Accidental nuclear excursion recuplex operation 234-5 facility: Final medical report.

Three individuals exposed to body doses of mixed neutron and gamma radiation ranging from 19 to 123 rems were observed following a criticality accident in a plutonium waste chemical recovery facility at the Hanford Atomic Products Operation. This report summarizes results of leukocyte cultures made from blood collected at 4 hours, 2, 4 and 6 weeks, 3 1/2 and 6 months, and 1 and 1 1/2 years after the accident. Results suggest that no change occurred in aberration frequency over the first 4 weeks. Rough estimates of dose were made from observed aberration rates.

29508 (HW—81010, pp 78) **Amino and excretion.** Howland, J.W.; Ganis, F.; Hendrickson, M.W. (Univ. of Rochester School of Medicine and Dentistry, NY (USA)). 7 Apr 1962. NTIS, PC A 05. Order Number DE88002340/JAW.

In Accidental nuclear excursion recuplex operation 234-5 facility: Final medical report.

Three individuals exposed to body doses of mixed neutron and gamma radiation ranging from 19 to 123 rems were observed following a criticality accident in a plutonium waste chemical recovery facility at the Hanford Atomic Products Operation. This report summarizes results of urinary amino acid patterns with particular emphasis in the following amino acids: cystine, histidine, proline, tryptophan, glycine, serine and beta-aminoisobutyric acid. No significant change in the excretion of these acids was observed in the Hanford casualties.

29509 (HW—81010, pp 79-87) **Studies of gonadal function following the recuplex criticality accident.** Paulsen, C.A.; deSouza, A. (Univ. of Washington School of Medicine, Seattle (USA)). 7 Apr 1962. NTIS, PC A 05. Order Number DE88002340/JAW.

In Accidental nuclear excursion recuplex operation 234-5 facility: Final medical report.

Three individuals exposed to body doses of mixed neutron and gamma radiation ranging from 19 to 123 rems were observed following a criticality accident in a plutonium waste chemical recovery facility at the Hanford Atomic Products Operation. This report summarizes the results of tests on gonadal function which included the following: testicular histology; seminal fluid examination; urinary gonadotrophin excretion; urinary estrogen excretion; and chromosomal studies of testicular tissue cultures. Results indicate that two of the three individuals sustained some gonad damage but values had returned to normal within 15 months. 4 figures, 3 tables.

29510 (HW—81010, pp 88) **Discussion and summary.** Norwood, W.D. 7 Apr 1962. NTIS, PC A 05. Order Number DE88002340/JAW.

In Accidental nuclear excursion recuplex operation 234-5 facility: Final medical report.

Three individuals exposed to body doses of mixed neutron and gamma radiation ranging from 19 to 123 rems were observed following a criticality accident in a plutonium waste chemical recovery facility at the Hanford Atomic Products Operation. This report summarizes the information obtained regarding exposure and clinical and laboratory observations over a period of twenty-one months. These studies failed to reveal any effects other than those of a transient nature.

29511 **(IC—87/106) Genetic disorders as collective phenomena.** Chela-Flores, J. (International Centre for Theoretical Physics, Trieste (Italy)). May 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702541/JAW.

Genetic disorders due to human chromosome aberrations in number are discussed from the point of view of Molecular Genetics. The etiology of trisomy is discussed in the light of the collective variables recently introduced and an age-dependent metabolic disorder is suggested as a possible etiological factor. (author). 11 refs.

29512 **(IC—87/185) Molecular pathways towards psychiatric disorders.** Chela-Flores, J. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702554/JAW.

The observed fibrillar-neuronal organization of the cerebral cortex suggests that in the aetiology of certain psychiatric disorders the genomic response of the neuron to the challenge presented by stress or insults at various stages of development, is to set off a programmed chain of molecular events (or "pathways"), as demonstrated in previous genetic studies. The understanding of these pathways is important in order to enhance our ability to influence these illnesses, and are hypothesized to be initiated by a nucleolar mechanism for inducing abnormal synthesis of the nerve growth factor (NGF). The hypothesis is used to approach tentatively the still open question regarding the pathogenesis of mental retardation (MR) and senile dementia (SD). (author). 25 refs.

29513 **(IC—87/186) Collective biology of neoplastic disease in dicotyledonous plants.** Chela-Flores, J. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702555/JAW.

We discuss the two different responses from the angiosperms to the specific molecular mechanisms of the tumor-inducing agent contained in the bacterium Agrobacterium tumefaciens. This is done in terms of the collective variables for expressing genetic response to a continuously varying supply of energy from metabolic pathways. We are led to the conjecture that the expression of the recessive oncogenes may not be restricted to humans (retinoblastoma and osteosarcoma), but may also occur in plants (crown gall), and be expressed through a heat-shock. (author). 11 refs.

29514 **(INIS-BR—990) Repair of near-UV (365nm or 313 nm) induced DNA strand breaks. The role of the pol A and rec A gene products.** Miguel, A.G. (Rio de Janeiro Univ. (Brazil). Inst. de Biofisica). 1981. 144p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88702574/JAW.

The action of near-UV (365 nm or 313 nm) radiation in cellular inactivaton (biological measurements) and induction and repair of breaks (physical measurements) is studied in repair proficient strain and in pol A, rec A and uvr A deficient strains of Escherichia coli K-12. (M.A.C.).

29515 **(INIS-mf—11672) Behaviour of the endocrinological parameters cortisol, testosterone, growth hormone and prolactin after UVA and UVB whole-body irradiation.** Hicke, M. (Muenchen Univ. (Germany, F.R.). Fakultaet fuer Medizin). 22 May 1986. 103p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88753307/JAW.

With two groups, each with 8 healthy subjects UV whole-body irradiation was carried out with uniformly 30 J/cm/sup 2/ UVA or respectively UVB at the level of the individual minimal erythema dose. Every subject received serial irradiations once a day for four days. The determination of the serum hormone level was accomplished by means of radioimmunoassays. The results show a weakly significant decline of cortisol 4 and 24 hours after 2 serial UVB irradiations. 3,5 and 7 days after the end of the irradia-

tion series the cortisol values have increased, but by the seventh day statistically only weakly significant. With UVA irradiation there was also a weakly significant increase in cortisol levels three days after the end of the irradiation series. The serum levels of the other hormones showed no statistically significant changes.

29516 **Comparison of dose-response models for death from hematological depression in different species.** Morris, M.D.; Jones, T.D. (Oak Ridge National Lab., TN (USA)). *International Journal of Radiation Biology and Related Studies in Physics, Chemistry and Medicine;* 53: No. 3, 439-456(Mar 1988).

A database has been completed suitable to study interspecific variability of radiosensitivity, dose-rate dependence of sensitivity, dose-response behaviour within each experiment, etc. Data compiled were restricted to continuous and nearly continuous exposures to photon radiations having source energies above 100 keV. Photon source energy, exposure geometry, and body weight considerations were used to select studies where dose to hematopoietic tissue was approximately uniform. The database reflects 13 mammalian species ranging in size from mouse to cattle. Some 211 studies were compiled, but only 105 were documented in adequate detail to be useful in development and evaluation of dose-response models of interest to human exposures. Of the 105 studies, 70 were for rodent species, 35 for non-rodent groups ranging from standard laboratory primates (body weight ~ 5 kg) to cattle (body weight ~ 375 kg). Seven different dose-response models are tested for validity against the 105 studies. In general, log transformation models did not improve model performance and extreme value models did not seem consistent with the preponderance of the data. Probit and the logistic models seemed preferable over the Weibull model.

29517 **Role of hydroxyl radical quenching in the protection by acetate and ethylenediaminetetraacetate of supercoiled plasmid DNA from ionizing radiation-induced strand breakage.** Blazek, E.R.; Peak, M.J. (Argonne National Lab., IL (USA)). *International Journal of Radiation Biology and Related Studies in Physics, Chemistry and Medicine;* 53: No. 2, 237-247(Feb 1988).

A supercoiled plasmid of 7300 base pairs was isolated and exposed in various aqueous environments to ^{60}Co gamma-radiation. Conversion of the supercoiled form to the relaxed circular and linear forms was monitored by agarose gel electrophoresis and quantified by fluorescence scanning of the gel. Acetate, which has been reported to affect the conformation of DNA in solution, decreased the radiosensitivity of the supercoil in a concentration-dependent manner. Acetate, formate, and azide anions, as well as mannitol, all protected the supercoil from relaxation in approximate proportion to the rate at which their solutions quench the hydroxyl radical. At concentrations greater than 300 mmol dm^{-3}, however, the efficiency of acetate radioprotection is reduced. Disodium ethylenediamine-tetraacetate protected the supercoil more efficiently than would be expected from the published value of its rate constant for quenching the hydroxyl radical.

29518 **Reducing the radiation dose from inhaled americium-241 using continuously administered DTPA therapy.** Guilmette, R.A.; Muggenburg, B.A. (Lovelace Foundation for Medical Education and Research, Albuquerque, NM (USA). Inhalation Toxicology Research Inst.). *International Journal of Radiation Biology and Related Studies in Physics, Chemistry and Medicine;* 53: No. 2, 261-271(Feb 1988).

Continuous infusion of a chelating agent, DTPA, was given to dogs that had inhaled a moderately soluble aerosol, $^{241}AmO_2$, not only to accelerate clearance of the radionuclide from the lung but also to prevent its deposition in liver and bone. Treatment was begun with an intravenous injection of CaDTPA 1h after exposure, and was continued for 64 days after exposure by implanting subcutaneously osmotic pumps containing ZnDTPA at 1 day after exposure. The results showed that the infusion therapy was effective in blocking the translocation of 99.5% of the ^{241}Am that would have been deposited in liver, and 98.3% of the ^{241}Am that would have been deposited in bone. This result was significantly better than the result achieved using repeated intravenous injections of DTPA, the method of treatment in current use for actinide contamination cases.

29519 **Potential lethal damage repair in confluent C3H10T1/2 cells irradiated by heavy ions.** Yang, T.C.; Craise, L.M.; Mei, M.T.; Tobias, C.A. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA 94720 (USA)). pp v of Thirty-fifth annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1987). (CONF-870221—). Contract AC03-76SF00098.

From 35. annual meeting of the Radiation Research Society; Atlanta, GA, USA (22 Feb 1987).

Mouse embryonic fibroblasts (C3H10T1/2) stop their growth at G/sub 1/-phase when they come in close contact with one another. This property of contact inhibition of growth makes these cells a useful model system for studying potential lethal damage (PLD) repair in G/sub 1/-phase mammalian cells. Using delayed-plating technique, the authors investigated the repair of PLD in confluent C3H10T1/2 cells irradiated by heavy ions with various LET values, up to 2000 keV/μm. The dose-modifying factor, determined at 10% survival level, was about 1.6 for low-LET radiation and decreased to 1.0 at about 300 keV/μm. The authors found that experimental data were fitted better with Z/sup *2//β/sup 2/ than with LET, suggesting PLD repair is track-structure dependent. For both immediate and delayed plating, the inactivation cross section approached the geometric nuclear area of the cell at very high LET. A simple analysis of experimental data indicated that an average of more than one particle traversed the cell nucleus per Do for high-LET heavy ions which induced no repairable lethal damage. The possible relationship between the energy density in the core of heavy-ion track and the repair of PLD is discussed.

29520 **Radiation-induced micronuclei in peripheral erythrocytes of Rana catesbeiana: an aquatic animal model for in vivo genotoxicity studies.** Krauter, P.W.; Anderson, S.L.; Harrison, F.L. (Lawrence Livermore National Lab., CA). *Environmental Mutagenesis;* 10: No. 3, 285-296(1987). Contract W-7405-ENG-48.

An in vivo micronucleus assay for peripheral erythrocytes of Rana catesbeiana tadpoles was developed and evaluated. The assay was used to determine the spontaneous frequency of micronuclei in circulating erythrocytes in tadpoles from two different populations, to define the time from administering the clastogen to the maximum micronucleus frequency in peripheral erythrocytes, and to determine the response to radiation. The spontaneous frequency of micronuclei in circulating erythrocytes of early-stage tadpoles was low, but higher than that of late-stage tadpoles. The time from the exposure of early-stage tadpoles to radiation (2.1 Gy) to the maximum micronucleus frequency was about 2 wk. The increase in frequency of micronuclei in peripheral erythrocytes of late-stage tadpoles receiving doses ranging from 0.5 to 3.0 Gy was linear with dose; a 3-fold increase was obtained with a dose of 3.0 Gy. The spontaneous frequency of micronuclei in erythrocytes and the increase in frequency induced by radiation appeared to differ in tadpoles from different populations. Quantification of micronuclei in the peripheral erythrocytes of R castesbeiana tadpoles provides a promising whole-animal system for studies of genotoxicity in aquatic environments.

29521 **Thermally activated free radical reactions in 5'dCMP crystals x-irradiated at 11K.** Bernhard, W.A.; Close, D.M.; Sagstuen, E.; Alexander, C. Jr. (Univ. of Rochester, Rochester, NY 14642). pp v of Thirty-third annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1985). (CONF-8505113—).

From 33. annual scientific meeting of the Radiation Research Society; Los Angeles, CA, USA (5 May 1985).

The free radical reactions in 5' dCMP crystals are being studied in order to determine feasible mechanisms for formation of single-strand breaks in DNA. Earlier ESR/ENDOR work has provided evidence that X-irradiation of 5'-dCMP crystals at room temperature leads to an allylic type of radical (3αH). Low temperature studies have shown that an alkoxy radical centered at 03' (03'), an electron loss radical at the base (C/sub c/), and two electron gain radicals (C/sub a1/ and C/sub a2/(, are trapped at 11K. Others identified a >CHCH/sub 2/ radical trapped at 77K. In the authors' current work the reactions of these low temperature radicals are

followed in an attempt to determine the precursors of the 3αH radical. The C/sub a1/, C/sub a2/, C/sub c/, and 03' radicals decay between 40K and 120K, leaving three different radicals. One of these is the C/sub a1/ radical protonated at C6, another is the >CHCH/sub 2/ radical and the third is unidentified. The authors are currently using ESR/ENDOR to track the fate of these radicals upon further warming. A working model of the free radical events in 5'dCMP is given.

29522 **Intercomparison of neutron facilities and chemical protectors.** Sigdestad, C.P.; Connor, A.M.; Grdina, D.J.; Hanson, W.R. (Argonne National Lab., Argonne, IL 60441). pp v of Thirty-third annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1985). (CONF-8505113—).

From 33. annual scientific meeting of the Radiation Research Society; Los Angeles, CA, USA (5 May 1985).

The authors previously showed that some WR radio-protectors are effective against high LET radiations. This paper describes the effects of three neutron beams (DOSAR at Oak Ridge, JANUS at Argonne and Fermi-Lab neutrons at Batavia, IL) on animal lethality and gut stem cell survival. Two radiation protective compounds (WR-2721, WR-151327) were compared for their ability to protect against the effects of these three neutron beams. Cobalt-60 effects with and without protector was comparatively tested. DOSAR and JANUS, both fission spectrum neutrons showed similar gut sensitivites [LD50(6)] about 250 cGy. Fermi-Lab neutrons with an average energy of 25 MeV (875 Cgy) was closer to the Cobalt-60 (1068 cGy) results. WR-151327 appears to be the better protector against the higher LET beams than is WR-2721, whereas the reverse is true for the low LET radiations. The details of the results and implications are presented.

29523 **Spin labeled DNA as a monitor of radiation damage to DNA.** Swarts, S.; Sevilla, M.D. (Dept. of Chemistry, Oakland Univ., Rochester, MI 48063). pp v of Thirty-third annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1985). (CONF-8505113—).

From 33. annual scientific meeting of the Radiation Research Society; Los Angeles, CA, USA (5 May 1985).

The attack of radiation produced free radical intermediates on DNA labeled with a nitroxide spin probe (TEMPO) has been investigated by electron spin resonance spectroscopy. The spin labeled DNA acts as a monitor of the degree of radiolytic damage to DNA. The spin label acts in this manner by its reaction with radiolytic intermediates to produce diamagnetic products;for example, reduction by the radiation produced electron results in the hydroxylamine whereas other radicals can result in direct adduct formation. Chemical reoxidation of the hydroxyl amine gives a measure degree of reduction. Experiments with the labels alone and with labeled DNA have shown that the reduction of the ESR signal is linear with dose over a range of concentrations. Results with N_20 saturated solutions show that the reductive pathway was eliminated as would be expected for direct electron attack on the probe. Certain radioprotective agents are found to efficiently direct radiation damage to the spin probe. Results found for radioprotectors, radiosensitizers, and DNA structure are discussed.

29524 **Role of DNA polymerase α in chromosomal aberration production by ionizing radiation.** Bender, M.A. (Medical Dept., Brookhaven National Lab., Upton, NY 11973). pp v of Hematopoietic cellular proliferation: An international conference in honor of Eugene P. Cronkite. Bond, V.P.; Chandra, P.; Rai, K.R. New York, NY; New York Academy of Sciences (1985). (CONF-8310231—). Contract AC02-76CH00016.

From International conference on hematopoietic cellular proliferation; Upton, NY, USA (6 Oct 1983).

The authors have shown that aphidicolin, like other inhibitors of DNA synthesis, both induces chromosomal aberrations in human peripheral lymphocytes and, as a post-treatment, interacts synergistically with X rays to produce greatly enhanced aberration yields. Because DNA polymerase α is the only DNA-synthetic or repair enzyme known to be affected by aphidicolin, the authors infer that this enzyme is directly involved in the repair of DNA lesions which, if unrepaired, can result in visible chromosomal aberrations. The present experiments were undertaken to further explore the effects of aphidicolin in human lymphocytes in the post-DNA-synthetic G_2 phase of the cell cycle. Earlier experiments in which cells were simply fixed at times after treatment when the frequency of metaphases in the DNA-synthetic S phase of the cell cycle is zero in typical percentage labeled mitoses curves for human lymphocytes did not completely rule out the possibility that the aberrations induced by aphidicolin actually arose in a small subpopulation of cells actually in the S phase, and not in G_2 cells. Furthermore, the yield of X-ray-induced aberrations in G_2 cells falls rapidly as a function of increasing irradiation-fixation interval, so comparisons of yields at particular fixation times can be misleading if the cells in each group do not progress through G_2 at the same rate. The experiments reported here utilized labeling with tritiated thymidine to positively identify cells in the S phase at the time of treatment and serial Colcemid collections and fixations to determine aberration yields over as much of the G_2 phase as feasible.

29525 **Changes in a herbaceous plant community during a three-year period following exposure to ionizing radiation gradients.** McCormick, F. Atlanta, GA; Emory University (1963). 5p.

Ionizing radiation has both stimulatory and inhibitory effects upon plant growth and survival. These ecological, morphological and physiological effects are reflected by species interactions at the community level. Certain post-irradiation changes in the spring flora are interpreted as resulting from a stimulating effect of low level ionizing radiation on Arenaria, endowing it with a capacity to dominate competition and thereby increase its density and distribution at the expense of Diamorpha and emerge as the dominant species in the succeeding generations studied. Other changes in the spring flora were due to the lethal and inhibitory effects of irradiation upon plant growth. Changes in the summer flora are interpreted as resulting from the selective elimination of more radiosensitive species and the subsequent positive selection pressure toward more radio-resistant species. Subsequent studies have been made of the post-irradiation physiological tolerances of the species studied to a variety of environmental situations. In all cases results agreed with those obtained during community analysis. 12 references, 8 figures.

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REFER ALSO TO CITATION(S) 28839, 28878, 29276, 29285, 29286, 29287, 29288, 29334, 29422, 29427, 29450, 29451, 29453, 29454, 29455, 29457, 29458, 29472

29526 (DOE/ER—0343, pp xiv-xv) **Metabolic and chemical determinants of polycyclic hydrocarbon induced cancer.** Wood, A.; Levin, W.; Conney, A.; Lehr, R.; Thakker, D.; Yagi, H.; Jerina, D. (Roche Research Center, Nutley, NJ (USA)). 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.).

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

Progress in the study of polycyclic aromatic hydrocarbons (PAH) and the chemical and metabolic determinants of their biological effects is reported. Studies have led to the formulation and verification of the bay-region theory which states that the formation of a bay-region diol epoxide metabolite of a PAH and its covalent interaction with a cellular target is a critical initiating event in PAH-induced cancer. Studies have further revealed a number of metabolic and chemical determinants that form the basis for three orders of magnitude differences in the tumorigenic potency of PAHs. Identification of a common ultimate carcinogenic metabolite has stimulated studies on the nature of the critical cellular target(s) of these electrophiles, and on the identification of normal body constituents which may block diol epoxide interaction with these targets.

29527 (DOE/ER—0343, pp 25-27) **Relationship between chemical structure of nitrofluorenones and nitrofluorenes and their genotoxic activity.** Brooks, A.L.; Kitchin, R.M.; Bechtold, W.E. (Lovelace Inhalation Toxicology Research Institute, Albuquerque, NM (USA)). 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.). Contract AC04-76EV01013.

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

Derivatives of nitrofluorene are an important class of environmental mutagens which have served as model compounds and positive controls for many studies using the Ames mutagenicity assay. These compounds have also been used as models to determine the mechanisms of interactions of nitroaromatics with DNA and to establish structure-function relationships for mutation induction in bacteria. In the current study, the genotoxicities of 2-nitrofluorene (2-NF), 2,7-dinitrofluorene (2,7-DNF), 3-nitroflorenone (3NFone), 2-nitrofluoreneone (2NFone), 2,7-dinitrofluorenone (2,7-DNFone), 2,4,7-trinitrofluorenone (2,4,7-TNFone), and 2,4,5,7-tetranitrofluorneone (2,4,5,7-TNFone) were related to chemical structure. By limiting this study to a single class of compounds it was possible to compare chemicals with similar molecular size, a constant plane for the aromatic rings, but with different numbers and types of electron withdrawing groups on the parent compounds. Mutations were evaluated using the Ames salmonella bacterial test. Toxicity, mutations at HGPRT gene loci and the induction of sister chromatid exchanges were measured using CHO cells.

29528 (DOE/ER—0343, pp 31-36) **Adduct formation and repair.** Geacintov, N.E. (New York Univ., NY (USA)). 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.).

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

This session dealt with a variety of approaches to the study and characterization of carcinogen-DNA and mutagen-DNA adducts, and the types of DNA damage induced by toxic chemicals. These approaches varied from basic chemical and theoretical studies of adducts, to molecular biology techniques. However, it is evidence that they still do not know which physicochemical and/or biochemical properties of adducts determine mutagenicity, nor the mechanisms by which the observed mutation and deletions are induced by some of these adducts.

29529 (DOE/ER—0343, pp 37-39) **Mechanisms of interactions and binding of carcinogenic polycyclic aromatic metabolites to DNA and relationships to biological activities.** Geacintov, N.E. (New York Univ., NY (USA)). 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.).

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

The correlation between the tumorigenic activities of 16 different PAH diol epoxide derivatives and the conformation of the DNA adducts formed is described. All of the highly tumorigenic and mutagenic enantiomers form predominantly external adduct conformations, while the less active or inactive stereoisomers form quasi-intercalative adducts. Computer modeling studies suggest that BPDE can form both base-stacked and external adducts. The intercalative adducts appear to give rise to a more severe disruption of the local DNA structure than the external adducts and thus are more likely to be excised by repair enzymes.

29530 (DOE/ER—0343, pp 46) **Chemical binding, damage and repair in mammalian germ cells.** Sega, G.A. (Oak Ridge National Lab., TN (USA)). 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.). Contract AC05-84OR21400.

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

Current studies are reported that focus on measuring the amounts of selected chemical mutagens that reach the germ cells in the mouse, determining if the molecular targets in the various stages may be different, how much DNA breakage is occurring in the different stages, and whether or not repair of DNA damage occurs in the germ cells. In the course of this research it has been found that: (1) Protamines as well as DNA are important molecular targets for chemical attack that may lead to chromosome damage. (The sperm protamines of both mouse and man are simple proteins that are intimately associated with DNA and found only in late-spermatid and mature-sperm stages.) (2) DNA repair can occur in a number of germ-cell stages in the male, but not in the most mature stages. (Their observation of a mutagen-induced DNA repair response in mouse germ cells has led to its development as a fast, sensitive and inexpensive screen for potential germ-cell mutagens.) (3) A pattern of DNA breakage can be measured in developing spermiogenic stages exposed to certain mutagens which parallels the pattern of sperm head alkylation and the pattern of induced dominant lethals and heritable translocations.

29531 (DOE/ER—0343, pp 47-49) **Illegitimate recombinants and DNA deletions induced by benzo[a]pyrene diol epoxide in Escherichia coli.** Weiss, S.B.; Kokontis, J. (Univ. of Chicago, IL (USA)). 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.).

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

The authors studies have employed the use of infectious viral nucleic acids as a probe to study modifications in DNA sequence arrangement induced by alkylation with (+)-BPDE [(+)-anti-7β,8α-dihydroxy-9α,10α-epoxy-7,8,9,10-tetrahydrobenzo[a]pyrene. Synthetic duplex DNA oligomers were prepared containing a single alkylated site in each duplex DNA strand. Several ds oligomers were synthesized such that the nucleotide base alkylated and the distance between the alkylated residues would vary for each oligomer construct. Findings indicate that when the construct contained BP-adducts, two major types of modifications in DNA sequence arrangement were found, large deletions and illegitimate (nonhomologous) recombinants which resulted in complete removal of the inserted oligomer. Both types of modifications appear not to be under control of the RecA gene. As the distance between the alkylated residues in the duplex strands was increased, the number of recombinants detected was reduced. In addition to deletions and nonhomologous recombinants, the E. coli repair system is capable of restoring the original nucleotide sequence of the alkylated construct. The detection of BP-DNA repair by illegitimate recombination, with recombinants ranging from 104 to 698 base pairs in size has not been previously observed. All of the DNA recombinant segments examined so far are derived from Alu I sites (AGCT) in M13 DNA. The mechanism by which DNA BP-adducts induces the exchange of DNA strands which requires double strand breaks, as is also the case with DNA deletions, is not presently clear.

29532 (DOE/ER—0343, pp 50-52) **Regional distribution of xenobiotic metabolizing enzymes and DNA adducts in the respiratory tract - relationship to respiratory epithelial populations.** Bond, J.A.; Harkema, J.R.; Mitchell, C.E.; Martin, L.; Russell, V.I.; Mauderly, J.L.; Wolff, R.K. (Lovelace Inhalation Toxicology Research Institute, Albuquerque, NM (USA)). 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.). Contract AC04-76EV01013.

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

Specific regions from one-half of the nasal, tracheal, bronchial, and pulmonary airways of dogs were excised and analyzed for the presence of xenobiotic metabolizing enzymes. Substrates for different isozymes of cytochrome P-450, including benzo[a]pyrene (BaP), nitropyrene (NP), ethoxycoumarin, and ethoxyresorufin as well as selected Phase II enzymes were measured. Experiments were also conducted in which rats were exposed nose-only to dilute diesel exhaust (10 mg particles/m^3) for up to 12 weeks. DNA adducts were measured in various regions of the respiratory tract after the 12-week exposure, using the highly sensitive ^{32}P-postlabeling assay. The data indicate that there are significant differences in the metabolic capability and DNA adduct distribution along the respiratory tract. Quantitative differences that were noted along the respiratory tract are probably due to both differences in the capability of a given region to metabolize the organic chemicals associated with diesel exhaust and differences in the deposition patterns of the diesel exhaust. Differences in the metabolic capability, and therefore DNA adduct distribution, along the respiratory tracts of

different species could explain, in part, why certain portions of the respiratory tract are more susceptible to tumor formation than are other portions.

29533 (DOE/ER—0343, pp 53-55) **Evaluation of the genetic effects of in vivo exposure to toxic agents: the mouse lymphocyte model.** Jones, I.M.; Tucker, J.D.; Carrano, A.V. 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.).

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

A mouse lymphocyte model has been developed to study mechanisms of mutation induction and the physiological and other factors that affect quantitation of somatic mutation in vivo. Sister chromatid exchange (SCE) is used to monitor the formation and persistence of DNA adducts and the frequency and spectrum of mutations of the hprt gene are measured as an indicator of genetic consequences of exposure to toxic agents. Together these approaches give them the ability to quantify the dose received, and the magnitude and molecular nature of specific induced genetic changes, in the target cells.

29534 (DOE/ER—0343, pp 59-64) **Summary of poster session.** Bhattacharyya, M.H.; Mast, T.J. (Argonne National Lab., IL (USA)). 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.).

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

The poster session provided an opportunity for presentations in areas ranging from molecular changes in response to carcinogen or teratogen exposure to sensitive new techniques for the monitoring of toxicants in the environment. The format allowed for in-depth discussion not afforded by the platform presentations and formed the basis for the development of a number of collaborations among investigators at the workshop.

29535 (DOE/ER—0343, pp 69-71) **Molecular events during tumor development.** Springer, D.L.; Mann, D.B.; Mahlum, D.D. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.).

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

In this work, mice were initiated dermally with BaP alone or with BaP in the presence of polycyclic aromatic hydrocarbon (PAH)-containing mixtures. Two weeks after initiation the animals were given twice weekly applications of 12-O-tetradecanoylphorbol acetate (TPA) for 6 months. The initiating activity of BaP was decreased by 10-60% when it was coadministered with the mixtures. Because co-administration of the mixtures decreased the initiating activity of BaP, they examined the binding of labeled BaP to DNA to determine if binding was decreased by the presence of the mixture. They found that the binding of BaP to DNA was inhibited to even a greater degree than was the initiating activity. Even a mixture that only minimally depressed initiating activity decreased binding by 50% while others that inhibited initiating activity by 40-60% decreased binding to approximately 20%. These data indicate that there is a non-quantitative relationship between DNA binding and tumor initiation, suggesting that initiation involves processes other than a simple interaction between the carcinogen and DNA. They are therefore examining the role of alterations in DNA adduction, adduct persistence, and changes in chromatin structure in the initiation process.

29536 (DOE/ER—0343, pp 72-75) **Recombinant DNA method for understanding the mechanisms behind Salmonella reverse mutations.** Felton, J.S.; Wu, R.; Shen, N.H.; Healy, S.K.; Fuscoe, J.C. 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.).

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

The specific sequence changes in the DNA of Salmonella revertants induced by a set of mutagens and metabolites were investigated. Most of these compounds were chosen because of their specificity to the frameshift strains TA1538 and TA98. The compounds used in the study were B[a]P, B[a]P diolepoxide, B[a]P 4,5-epoxide, Aflatoxin B_1, and the food mutagens, IQ, MelQ, and PhlP. The DNA of the Salmonella revertants induced by these compounds was extracted and cleaved with restriction enzymes so that the portion of the hisD gene of interest was incorporated in a 650 bp fragment. These size fractionated fragments were ligated to the bacteriophage vector M13mp8 and this mixture was used to transform E. coli. The recombinants were screened with a nick-translated hisD gene probe to identify the revertant gene sequence. All revertants sequenced were deletions. The mechanisms for induction of both the dinucleotide deletion and the larger deletions are not clear, but the aromatic amines have been shown to form C-8 adducts which could lead to a CG deletion. Studies are in progress to determine the role of repair on the types of deletions induced by PAHs and aromatic amines.

29537 (DOE/ER—0343, pp 78-80) **Differential effects of ethylene oxide in two strains of mice.** Popp, R.A.; Niemann, S.L. (Oak Ridge National Lab., TN (USA)). 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.). Contract AC05-84OR21400.

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

From studies with C57BL/6 male mice and SEC/R1 male mice, the authors have observed that somatic and germinal cells of the two strains are affected very differently by exposure to ethylene oxide (EO). Genetic studies reveal that these differences are controlled by a single pair of recessive genes. They are attempting to identify the gene, to map it to a specific chromosome, to learn how the gene product metabolizes EO to cause lethality in SEC but not in C57BL mice, and to determine whether homologous genetic and biochemical factors exist in humans to detoxify EO and its metabolites.

29538 (DOE/ER—0343, pp 81-83) **Deposition of ultrafine particles in a human nasal cast.** Yeh, H.C.; Cheng, Y.S.; Yamada, Y.; Swift, D.L. (Lovelace Inhalation Toxicology Research Institute, Albuquerque, NM (USA)). 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.). Contract AC04-76EV01013.

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

A human nasal cast and monodisperse aerosols were used to determine deposition of ultrafine particles with diameters between 0.004 and 0.2 μm. The inspiratory flow rates were between 4 and 60 l/min. The deposition efficiency was obtained by measuring the aerosol concentrations at the inlet and outlet of the cast, using a continuous flow condensation nucleus counter. Similar pressure drops were obtained for both inhalation and exhalation modes. These results are comparable to those obtained in vivo, suggesting that the cast will be a useful model for deposition studies. The deposition efficiency in the nasal passage for the inspiratory mode is shown as functions of particle size and flow rate. The deposition efficiency increased with decreasing particle diameter and flow rate, confirming that diffusional transport is the dominant mechanism of deposition of submicron particles.

29539 (DOE/ER—0343, pp 84-86) **Metallothionein: a lactation-induced cadmium-binding protein.** Bhattacharyya, M.H.; Solaiman, D.; Garvey, J.S.; Miyazaki, W.Y. (Argonne National Lab., IL (USA)). 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.).

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

Results are reported of a study conducted to test the hypothesis that increases in cadmium deposition during midlactation are caused by an induction of the metal-binding protein, metallothionein (MT). A cadmium/hemoglobin (Cd/Hb) assay for MT (which measures heat-stable cadmium binding capacity in tissues) was used to determine MT concentrations in the heat-treated supernatant fractions of kidney, liver, duodenum, and jejunum from five groups of B6CF1/ANL female mice. Portions of the same supernatants were also analyzed for MT by radioimmunoassay (RIA). Results show that metallothionein (or an MT-like cadmium-binding protein) increases in concentration in liver, kidney, and duodenum of mouse dams during lactation and decreases to levels found in nonpregnant controls by 5 days after weaning. They have evidence that the MT

that appears in the liver of midlactating mice exists in two forms, a native form that chromatographs with a Ve/Vo = 1.6 and reacts strongly with MT antibody, and a second form that appears with heating or storage in the freezer (data not shown), reacts less strongly with MT antibody, and chromatographs with a lower apparent molecular weight (Ve/Vo = 2.2).

29540 (DOE/ER—0343, pp 88) **Base displacement by AAF in a double stranded B DNA dodecamer: molecular views from minimized potential energy calculations.** Broyde, S.; Hingerty, B.E. (New York Univ., NY (USA)). 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.). Contract AC05-84OR21400.

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

The authors have computed energy minimized structures of base displacement in an AAF modified B DNA dodecamer. A rational search strategy, beginning with a global search of the conformation space of the modified deoxydinucleoside monophosphate, together with model building by computer graphics, have been employed. A number of different minimum energy conformations have been located which reveal base displaced structures. These show fluorene interstrand stacking, fluorene inter- and intra-strand stacking, and non-stacked fluorene situated in the denatured bulge. One structure of special interest offers a molecular view that suggests how AAF can induce the -2 deletion mutation observed in AAF modified E. coli. Other interesting structures are compatible with the large mutations associated with AAF modification in Chinese Hamster Ovary Cells.

29541 (DOE/ER—0343, pp 90) **Synthesis and conformation of a dinucleoside monophosphate modified by aniline.** Jacobson, M.D.; Shapiro, R.; Underwood, G.R.; Broyde, S.; Verna, L.; Hingerty, B.E. (New York Univ., NY (USA)). 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.). Contract AC05-84OR21400.

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

The modified dinucleoside monophosphate, N-deoxycytidilyl-(3'-5')-guanosin-8-yl)-aniline (dCprG-An) has been prepared by the phosphotriester synthesis approach, using suitably blocked derivatives of dCp and N-(guanosin-8-yl)-aniline (rG-An). The latter compound was synthesized by a route that featured nucleophilic displacement by aniline upon an 8-bromoguanosine derivative. A number of attempts to prepare N-(deoxyguanosin-8-yl)-aniline (dG-An) by electrophilic substitution, using activated aniline derivatives, failed. Nucleophilic substitution reactions of aniline with 8-bromodeoxyguanosine derivatives afforded only the base, N-(guanin-8-yl)-aniline. The conformation of dCprG-An has been studied by circular dichroism, proton magnetic resonance and minimized potential energy calculations. A flexible molecule with a mixture of conformers is indicated. Base-base stacked states predominate, in contrast to the case of a dimer containing 4-aminobiphenyl bound to the 8-position of guanine, where carcinogen-base stacked states are dominant.

29542 (DOE/ER—0343, pp 92-94) **Pulmonary hypoplasia in rats prenatally exposed to coal-derived complex mixtures: histological and subcellular development.** Mast, T.J.; Rommereim, R.L.; Young, J.S. (Battelle-Pacific Northwest Lab., Richland, WA (USA)). 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.). Contract AC06-76RL01830.

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

Timed-pregnant Sprague-Dawley rats were dermally exposed to coal-derived complex mixture (CM) or to a vehicle control. The CM was applied to the shaved backs of dams in a constant dosing volume of 1.0 ml/kg, on 11-15 days of gestation (dg). Groups of dams were serially sacrificed on 16-22 dg. For comparative purposes another group of dams was given the synthetic glucocorticoid, triamcinalone, as a subcutaneous injection, days 11-14 dg, 0.25 mg/kg/day. This group was sacrificed on 20 dg. Examination of electron micrographs taken of the serially sacrificed lungs revealed that differences in alveolar epithelial cell development between the treated and control lungs was evident as early as 17 dg. When compared to controls, hypoplastic lungs had less organization in the interstitial tissue, an increased septal thickness. However, bronchial and bronchiolar regions of the hypoplastic lungs appeared normal. Data indicate that functional impairment may result from abnormal development of the alveolar region. The similarity between the overall effects of the glucocorticoid treatment and those noted as a result of treatment with complex mixtures may imply a common mechanism.

29543 (DOE/ER—0343, pp 95) **Metabolism of benzo(a)pyrene in human mammary epithelial cells and its consequences.** Bartley, J.C.; Leadon, S.A.; Stampfer, M.R. (Lawrence Berkeley Lab., CA (USA)). 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.).

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

Recent studies have been initiated on the role of environmental carcinogens in the induction of oxidative damage in human mammary epithelial cells (HMEC), particularly to DNA. A monoclonal antibody that recognizes thymine glycols in DNA has been developed for this purpose. The electrophiles formed during metabolism of BaP can, of course, give rise to free radical intermediates and reactive reduced oxygen species. Their studies demonstrate that the induction of oxidative damage to DNA by BaP exposure is apparently equal to or greater than that due to direct formation of bulky adducts. The fact that superoxide dismutase (SOD) provides protection against the induction of oxidative damage to DNA, without affecting the overall metabolism of BaP, indicates that generation of super oxide is likely involved. When compared to equitoxic doses of ionizing irradiation, in which free radicals are responsible for the majority of the DNA damage, the extent of thymine glycol formation was approximately 35-fold greater in HMEC cultures exposed to BaP than to gamma irradiation. Current investigations on the possible mechanism(s) for production of reduced oxygen species from BaP metabolism were discussed.

29544 (DOE/ER—0343, pp 96-98) **Mechanisms of late-occurring degenerative lung disease.** Henderson, R.F.; Benson, J.M.; Pickrell, J.A.; Sun, J.D.; Harkema, J.R.; Hahn, F.F. (Lovelace Inhalation Toxicology Research Institute, Albuquerque, NM (USA)). 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.). Contract AC04-76EV01013.

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

Inflammatory processes in the lung may lead to normal repair or to late-occurring degenerative diseases such as fibrosis or emphysema. Two animal models are being used to investigate the mechanisms controlling the sequelae of inflammatory processes. In the first model, rodents were exposed for up to 30 months to diluted diesel exhaust. Rats developed more extensive pulmonary fibrosis than mice, despite a higher relative lung burden of diesel soot in mice. The resistant species, mice, were exposed to a known fibrogenic agent, ozone, and then were made deficient in GSH by administration of buthionine sulfoximine (BSO) in the drinking water. The BSO treatment greatly exacerbated the fibrosis induced by ozone exposure of mice. In a second animal model, rats and mice exposed to several metallic compounds were found to develop either fibrosis (mice) or emphysema (rats). This species difference provides an opportunity to study the factors controlling the development of each type of disease. A great inflammatory response was observed in the rats than the mice exposed to the compounds in vivo. In vitro studies indicated that the metallic compounds were more toxic to rat than to mouse pulmonary macrophages. Hypotheses to explain the species differences in response to diesel exhaust, ozone and metallic compounds have been tested and will be tested in ongoing studies.

29545 (DOE/ER—0343, pp 121-123) **Metabolism and genotoxicity of aromatic amines in aquatic organisms.** Knezovich, J.P.; Krauter, P.W.; Lawton, M.P.; Harrison, F.L. 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.).

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

Marine mussels (Mytilus edulis) and bullfrog tadpoles (Rana catesbeiana) were used to investigate the comparative metabolism and genotoxicity of aromatic amines in vivo. These organisms were selected because they possess distinctly different metabolic capabilities: mussels lack an active mixed-function-oxidase enzyme system that is present in most other organisms, including amphibians. Using ^{14}C-labeled chemical probes (o- and p-toluidine, 2-aminofluorene (2-AF), and 2-acetylaminofluorene (2-AAF)), mussels and tadpoles well dosed with individual compounds by direct immersion in aqueous solutions. The identities of metabolites were then determined by HPLC and GC/MS methods. Results indicate that the N-conjugating pathways used by mussels result primarily in the detoxification of aromatic amines by limiting the amount of primary amine available for activation. The tadpoles excreted a number of 2-AAF metabolites but did form DNA and protein adducts in the liver. Induction of micronuclei in the peripheral red blood cells was also demonstrated. The tadpole was shown to be a sensitive biological indicator of pollution in aquatic ecosystems.

29546 (DOE/ER—0343, pp 124-126) **Measurement of multiple endpoints of genotoxicity in a Chinese hamster ovary triple auxotroph: response to 1,2-dicarbonyl compounds.** Taylor, R.T.; Hanna, M.L.; Tucker, J.D.; Rinkus, S.J. 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.).

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

Upon 20-22 h exposures to varying concentrations of the 1,2-dicarbonyls, conditions were devised to measure quantitatively five endpoints of genotoxicity in CHO AUXB1. Methylglyoxal was examined in detail for direct DNA damage. It causes a dose-dependent increase in both DNA-protein crosslinking, as well as single-strand breaks. A methylglyoxal concentration of 1.0 mM induces single-strand breaks in CHO AUXB1 with a potency that is equivalent to about 190 Rads of ^{137}Cs irradiation. Bisulfite (10 mM) cotreatment completely negates both types of methylglyoxal DNA-lesions. Other 1,2-dicarbonyls are currently under study by the alkaline elution method. The results demonstrate that, as a class of compounds, 1,2-dicarbonyls are moderately potent genotoxins to cultured mammalian cells. They (1) suggest that 1,2-dicarbonyls induce reversion at the FPGS locus by a G-C to A-T base-substitution mechanism, (2) support their view that this mutation assay is sensitive preferentially to agents that are known to react with guanine bases in DNA, and (3) illustrate the versatility of the CHO AUXB1 cell line as a supplemental genotoxin assay system. Future work will be directed at the isolation and identification of exocyclic-ring DNA-base adducts from 1,2-dicarbonyl treated CHO AUXB1 cells.

29547 (DOE/ER—0343, pp 129-133) **Inhalation toxicology.** Hobbs, C.H. (Lovelace Inhalation Toxicology Research Institute, Albuquerque, NM (USA)). 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.).

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

Papers presented in this session of the DOE Contractors Meeting on Chemical Toxicity demonstrate the diversity of biological effects that may result from the inhalation of energy-related chemicals. The studies conducted are concerned with the mechanisms by which inhaled materials cause the health effects. These studies also provide a bridge between in vitro and in vivo studies on the mechanisms of chemical toxicity.

29548 (DOE/ER—0343, pp 134-136) **Hemotoxicity of ethylene oxide in mice.** Popp, R.A.; Hand, R.E. Jr.; Mann, R.C.; Popp, D.M. (Oak Ridge National Lab., TN (USA)). 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.). Contract AC05-84OR21400.

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

Because exposure to ethylene oxide (EtO) has been reported to adversely affect the hemopoietic system, studies were designed to identify and quantify EtO-induced perturbations in peripheral blood and bone marrow of adult mice and in hemopoietic progenitor cells of fetal mice. C57BL mice were exposed in 1.5 m^3 inhalation chambers to 255 ppm EtO for 6 hours a day and 5 days a week. Analyses made after 1, 2, 4, 8 and 14 days and after 4, 6, 8 and 20 weeks of exposure to EtO included hematology, CFU-S^2 (stem cell) and mutation assays, and cytometry (FCM) analysis. The results showed that FCM analysis of mixed cell populations in bone marrow was useful in identifying the effect of EtO on specific cells. Gas sterilizer operators are more likely to be exposed to short bursts of high levels of EtO so C57BL and SEC mice were explored to 1500 ppm EtO for 10 minutes twice a day for 4 days and its effect at daily intervals on the hematology of exposed mice was studied. Significant depression in lymphocytes and granulocytes occurred in both strains after 2 and 4 exposures. The effects of EtO on the developing hemopoietic system in the fetal liver of embryos were also examined. The exposure of C57BL mice to 255 ppm EtO 6 hr a day for 4 days caused a 60% reduction of fetal weight, 65% reduction in cellularity, 68% reduction in incidence of CFU-S and a 43% reduction of hemopoietic stem cells.

29549 (DOE/ER—0343, pp 137-139) **Cell kinetics in the lung as a predictive tool in the assessment of fibrogenesis and tumorigenesis.** Witschi, H. (Oak Ridge National Lab., TN (USA)). 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.).

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

Studies are reported of lung cell kinetics and the relationship between cell injury and repair in lungs after damage by inhaled toxic materials. Mice were treated with three cytostatic drugs: cyclophosphamide, busulfan, or 1,3-Bis540-2-chloroethyl)-1-nitrosourea (BCNU). The alveolar labeling index was measured following drug administration with a pulse of tritium-labeled thymidine and autoradiography. Results show that proliferation of type II alveolar cells was never a prominent feature. This is in contrast to animals treated with oleic acid in which there was an initial burst of type II cell proliferation. Studies with BHT suggest that cell hyperplasia is not a prerequisite for tumor promotion in mouse lung.

29550 (DOE/ER—0343, pp 150-152) **Genotoxicity and carcinogenicity of diesel soot and oil shale dust, two markedly different particles with associated organic content.** Mauderly, J.L.; Barr, E.B.; Bechtold, W.E.; Bond, J.A.; Brooks, A.E.; Eidson, A.F.; Harkema, J.R.; Henderson, R.F.; Jones, R.K.; McClellan, R.O.; Randerath, K. (Lovelace Inhalation Toxicology Research Institute, Albuquerque, NM (USA)). 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.). Contract AC04-76EV01013.

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

Levels of DNA adducts in lungs of rats were measured by ^{32}P postlabeling techniques after 240-mo exposure to either diesel exhaust or oil shale dusts. Preliminary results suggest that whole-lung adduct levels from chronic inhalation exposures are not predictive for carcinogenicity. Lung tumors were observed in animals exposed to diesel exhaust. Carcinogenicity was correlated to the mutagenicity of extracts and severity of epithelial proliferation.

29551 (DOE/ER—0343, pp 155-158) **Gene regulation.** Herschman, H.R. (Univ. of California, Los Angeles (USA)). 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.).

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

The presentations and discussions in this session emphasized the importance of obtaining fundamental knowledge in the areas of mechanisms of regulation of transcription in normal systems as a key prerequisite in understanding how metals and chemicals alter these controls to produce pathologic events. However, it also became clear that the intensive efforts to identify the specific sites of interactions of heavy metals, carcinogens, tumor promoters, and other types of environmental agents have lead to fundamental insights into mechanisms of gene regulation that will have important practical consequences in medicine and epidemiology.

29552 (DOE/ER—0343, pp 163-166) **Monitoring the effects of toxic chemicals on protein expression.** Giometti, C.S.; Taylor, J. (Argonne National Lab., IL (USA)). 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.). Contract W-31-109-ENG-38.

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

Two-dimensional gel electrophoresis coupled with computer-assisted image and data analysis was used to monitor protein populations for both qualitative and quantitative changes induced by exposure to chemicals. For mutagenesis studies designed to screen for heritable mutations, a computer-assisted search of the optical density data from 2DE patterns was used to look for (a) new protein spots, (b) missing protein spots and/or (c) altered expression of normal protein spots. Using this approach, 320 mice were screened for mutations induced by treatment of sires with 150 mg/kg body weight of ethylnitrosourea (ENU) and four different mutations were identified. Protein patterns from 105 offspring from untreated male mice (controls) and 369 offspring from irradiated male mice (3 Gy gamma) were also screened. No heritable mutations were found in those data sets, however. In addition, protein changes were observed in livers of animals exposed to the hepatocellular peroxisomal proliferation agents (and carcinogens) Wy-14,643 and DEHP. The de novo synthesis of a new protein by these agents was demonstrated and quantitated.

29553 (DOE/ER—0343, pp 167-169) **Modulation of gene expression by tumor promoters: rapid, transient induction by tetradecanoyl phorbol acetate of a group of genes that includes the C-FOS oncogene.** Herschman, H.R.; Lim, R.; Varnum, B.; Kujubu, D. (Univ. of California, Los Angeles (USA)). 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.).

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

A selective procedure was used to isolate TPA nonproliferative varians of 3T3 cells. These variants have normal levels of protein kinase C (the molecular target of TPA-induced cellular activation) and phosphorylate appropriate substrates, despite their inability to divide when challenged with TPA. They do not, however, show the characteristic transient elevation in ornithine decarboxylase (ODC) activity associated with TPA-induced proliferation, although serum - a competent mitogen - does induce this activity. TPA-induced transcription of quiescent genes is not universally turned off in these TPA nonproliferative cells; TPA can induce MEP (major excreted protein) mRNA in this variant as well as it can in parental cells. To approach the molecular basis for the action of this potent modulator of biological responses, a family of primary response genes (i.e. genes whose induction is independent of concurrent protein synthesis) has been cloned whose expression is induced by TPA. Hybridization studies demonstrated that this group of genes included the c-fos oncogene.

29554 (DOE/ER—0343, pp 173-175) **Metals toxicity.** Vanderlaan, M. 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.).

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

The biological effects of metals are described in the three papers of this session. Studies included: the development of a mouse model for the study of the effects of cadmium on the bones of postmenopausal women; the use of in vivo footprinting to identify changes in chromatin structure in the metallothionein gene promoter in response to cadmium in intact rat hepatoma cells; and the development of a dog model for the induction of granulomatous lung disease by inhaled beryllium.

29555 (DOE/ER—0343, pp 176-178) **Cadmium and postmenopausal bone loss.** Bhattacharyya, M.H.; Whelton, B.D.; Stern, P.H.; Peterson, D.P.; Moretti, E.S.; Dare, H.A. (Argonne National Lab., IL (USA)). 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.).

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

A mouse model was developed to study the effects of cadmium on bones in postmenopausal women. The combined effects of cadmium and ovariectomy were synergistic for inducing weight loss in bones. In an in vitro incubation of bone prelabeled with ^{45}Ca, Cd was shown to cause bone resorption directly. It was suggested that because cigarette smoking is a significant source of exposure to Cd, Cd-induced loss of bone mineral may contribute to the increased incidence of osteoporosis in women who are heavy smokers.

29556 (DOE/ER—0343, pp 179-180) **Modulation of gene expression by heavy metals: alterations of the structure of the rat metallothionein gene that accompany transcription induced by cadmium.** Andersen, R.D.; Taplitz, S.; Herschman, H.R. (Univ. of California, Los Angeles (USA)). 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.).

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

The authors have used the methodology of genomic sequencing (also termed in vivo footprinting), using the chemical reagent dimethyl sulfate (DMS) on intact cells, to observe changes in reactivity of the N-7 position of guanine residues in the promoter of the rat MT-1 gene in vivo following treatment of cells with cadmium ions. Transfection experiments with portions of the MT-1 promoter fused to a reporter gene were used to correlate the functional role of these sequences with the observed changes in their DMS reactivity.

29557 (DOE/ER—0343, pp 181-183) **Granulomatous lung disease from inhaled beryllium.** Haley, P.J.; Hahn, F.F.; Finch, G.L.; Mewhinney, J.A. (Lovelace Inhalation Toxicology Research Institute, Albuquerque, NM (USA)). 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.). Contract AC04-76EV01013.

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

In this present study, Beagle dogs were exposed to low and high concentrations of beryllium oxide calcined at two different temperatures (500°C, 1000°C). Dogs were then divided into two groups, one of which was sacrificed at intervals for characterization of lung histologic lesions, while the other group was maintained for sequential bronchoalveolar lavage and assessment of lung lymphocyte hypersensitivity to beryllium. This report deals only with the histologic lesions observed during the first year after exposure. Results indicate that inhalation of beryllium aerosols results in granulomatous lung disease; however, the histologic lesions found did not follow a distinct pattern attributable to dose or calcination temperature of the compound. There was a great deal of individual variation in the severity of lesions among exposed dogs, a phenomenon also observed in man. The observation that lung lesions appear to wane with time suggest that (a) the dogs sampled at the later times were not susceptible, (b) insufficient beryllium was administered in the single exposure to maintain the disease process or (c) some of the lesions resolved. Analysis of the burdens of beryllium indicated that most of the 500°C beryllium was cleared by 180 days after exposure. It was this more soluble form that produced the most consistent lesions.

29558 (DOE/ER—0343, pp 187-190) **Biological mechanisms.** Vanderlaan, M. 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.).

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

In two papers of this session, new animal models were developed for evaluation of reproductive effects after exposure to xenobiotic chemicals. Two papers reported the use of in vivo models for study of the regulation of cell transformation and differentiation. Finally, one paper presented several speculative ideas about how future studies might link human tumors and animal models for carcinogenesis.

29559 (DOE/ER—0343, pp 191-192) **Dominant lethality in embryos from parents treated with chemotherapeutic drugs.** Goldstein, L.S.; Ross, G.Y.; Florence, J.F.; Charron-Vennari, J. (Univ. of California, San Francisco (USA)). 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.).

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

In order to examine the mutagenic hazards due to multidry chemotherapy and to investigate possible alternatives, male mice were treated with clinically relevant doses of drugs and their reproductive fitness assayed in an in vitro dominant lethal assay. Results show that a variety of drugs used in cancer therapy as well as two known mutagens, radiation and methylmethanesulfonate, gave positive results in an analysis of the long-term mutagenic hazards in mammalian germ cells.

29560 (DOE/ER—0343, pp 193-194) **Exposure of mouse zygotes to chemical mutagens: a source of congenital anomalies.** Generoso, W.M. (Oak Ridge National Lab., TN (USA)). 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.). Contract AC05-84OR21400.

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

The effects of ethylene oxide (EtO) and ethyl methanesulfonate (EMS) were studied either before they were mated (treatment of preovulatory mouse oocytes) or after mating (treatment of zygotes and two-cell embryos). EtO was given by inhalation and EMS by i.p. injection. The major finding concerns midgestation and late fetal death and congenital defects among some of the surviving fetuses. High incidences of these endpoints were induced by both mutagens, but the time window during which the effects were inducible was narrow. Large effects were observed when female mice were exposed at the time of fertilization of their eggs or during early pronuclear stage of the zygote (before DNA synthesis). The effects were absent or minimal when females were exposed either before copulation or after the fertilized egg had progressed to the stage of pronuclear DNA synthesis or had reached the two-cell stage. Molecular techniques, are presently being used to investigate possible new genetic mechanisms responsible for the zygote-derived congenital defects.

29561 (DOE/ER—0343, pp 201-202) **Control of mutagenesis and cell differentiation in cultured human cells.** Huberman, E. (Argonne National Lab., IL (USA)). 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Summs.). Contract W-31-109-ENG-38.

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

Using an in vitro cell-mediated mutagenicity assay with Chinese hamster V79 or human P3 cells as targets, a relationship was shown between the degree of mutagenesis by various chemical carcinogens in this assay and their tumor-producing potential in experimental animals. However, these types of studies usually do not involve growth control genes. To address this issue, carcinogen-induced alterations were studied in a gene that codes for an enzyme involved in the regulation of cell growth: inosine 5'-monophosphate dehydrogenase (IMPDH). An increase in the activity of this enzyme is also associated with development of malignancy and tumor growth progression. On the basis of these experiments, it is suggested that a carcinogen insult may affect tumor initiation and more likely tumor progression by amplifying various genes, including those that control cell growth. On the basis of studies with human HL-60 leukemia cells, the author speculates that during tumor promotion, phorbol diesters cause the migration of protein kinase C to the vicinity of the nuclei of the treated cells. In the nucleus, through phosphorylation of regulatory proteins, the kinase causes the expression of genes that control cell growth. The expression of these growth control genes may cause the selective clonal expansion of initiated cells and eventually tumor formation.

29562 **Binding of ethylene oxide in spermiogenic germ cell stages of the mouse after low-level inhalation exposure.** Sega, G.A.; Owens, J.G. (Oak Ridge National Lab., TN). *Environmental Mutagenesis;* **10**: No. 2, 119-127(1987).

Mice received inhalation exposures of ^{3}H-labeled ethylene oxide (EtO) gas at levels from 0.65 to 3.2 parts per million-hours (ppm-hr), which are below the exposure limits currently allowed for humans. Subsequently, spermatozoa were recovered from the reproductive tracts of the animals over a two-week period and assayed for the amount of bound EtO. A strong increase in the level of EtO binding occurred in late spermatid stages; these stages are also genetically sensitive to the action of EtO. Alkylation of the DNA within the sperm accounted for a very small fraction of the total sperm head alkylation, averaging about 20 DNA alkylations per sperm per ppm-hr of exposure over the two-week period. However, alkylation of protamine, a protein unique to sperm cells, was found to be correlated with total sperm head alkylation and accounted for nearly all of the EtO binding. Protamine alkylation appears to be a significant cause of EtO-induced genetic damage in spermiogenic cells of the mammal.

5604 Other Environmental Pollutant Effects

REFER ALSO TO CITATION(S) 29470

29563 **Proceedings of the sixth symposium and technical exhibition on electromagnetic compatibility.** Berkeley, CA; Lawrence Berkeley Laboratory (1985). 205-210p. Contract AC03-76SF00098.

The Lorentz force exerted on moving electrolytes leads to interactions between an applied stationary magnetic field and the electrical conduction processes that occur as part of several important biological functions. These include blood circulation, nerve impulse propagation, and visual phototransduction. Sensitive electrical recording techniques have been used in our laboratory to detect alterations in the properties of these biological systems during the application of stationary magnetic fields up to 2 T (1 Tesla = 10^4 Gauss). The principal results of these studies, and the correlation between experimental observations and theoretical predictions, are described. 17 references, 4 figures.

57 HEALTH AND SAFETY

29564 **(SAND—87-2877) Analysis of samples from fire in microcircuits production facility.** Weissman, S.H. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1988. Contract AC04-76DP00789. 40p.

A fire occurred in the furnace exhaust ductwork in Bldg. 870 of the Bendix Albuquerque Operations on July 27, 1987. The Materials Characterization Department, 1820, was asked to characterize material associated with the fire. The fiberglass reinforced polyester ductwork was analyzed and determined not to have contained the fire retardant resin which was specified during construction. One of several residues identified was cyclohexylamine hydrochloride. The source of the material was not identified, but its precursor (cyclohexylamine) is considered to be a dangerous fire risk. By measuring the relative intensity of Raman peaks from carbon residues, we determined that the carbon residues remaining on the ductwork were exposed to temperatures ranging from 400 to 1000/sup 0/C (+- 100/sup 0/C). These temperatures are substantially below what would have been expected for a hydrogen fire. The major reason that a sustained fire occurred was that the ductwork was substandard. Three possible ignition sources were identified: self-ignition of the ductwork from overheating, hydrogen flash, or cyclohexylamine flash. 8 figs., 5 tabs.

58 GEOSCIENCES

5801 Geology And Hydrology

29565 **Airflow-terrain interactions through a mountain gap, with an example of eolian activity beneath an atmospheric hydraulic jump.** Gaylord, D.R.; Dawson, P.J. (Washington State Univ., Pullman (USA)). *Geology;* **15**: No. 9, 789-792(Sep 1987).

The integration of atmospheric soundings from a fully instrumented aircraft with detailed sedimentary and geomorphic analyses

of eolian features in the Ferris dune field of south-central Wyoming lends insight into the manner in which topography interacts with airflow to modify eolian activity. Topographically modified airflow results in zones of airflow deceleration, acceleration, and enhanced atmospheric turbulence, all of which influence the surface morphology and sedimentology. Extreme lateral confluence of prevailing airflow produces accelerated, unidirectional winds. These winds correlate with unusually continuous and elongate parabolic dunes that extend into a mountain gap (Windy Gap). Persistently heightened winds produced at the entrance to Windy Gap have resulted in a concentration of active sand dunes that lack slipfaces. Common development of a strongly amplified atmospheric wave analogous to a hydraulic jump in the gap contributes to the formation of a variety of eolian features that mantle the surface of Windy Gap and the Ferris dune field tail. Heightened, unidirectional winds in this zone promote grain-size segregation, the formation of elongated and aligned sand drifts, climbing and falling dunes, elongate scour streaks, and parabolic dunes that have low-angle (< 20°) cross-stratification. Deflation of bedrock and loose sediment has been enhanced in the zone of maximum turbulence beneath the hydraulic jump.

29566 **Thermal maturity of the Cambria slab, an inferred trench-slope basin in central California.** Underwood, M.B.; Howell, D.G. (Geological Survey, Menlo Park, CA (USA)). *Geology;* **15**: No. 3, 216-219(Mar 1987).

Well-bedded and variably deformed Upper Cretaceous strata of the Cambria slab are in contact with highly deformed melange of the Franciscan Complex along the coast of central California. Past interpretations drew an analogy between these strata and small intraslope basins that highlight modern trench slopes. The authors have tested this hypothesis by integrating structural data with estimates of paleotemperature, using the technique of vitrinite reflectance. The maximum burial depth for Cambria deposits was about 6.5 km, and the paleogeothermal gradient was approximately 30 C/km. The timing of peak heating remains uncertain, however. Maturation gradients and anomalies expressed at the surface are consistent with the slope-basin model, but the Cretaceous structural architecture has been modified considerably by Cenozoic folding and faulting. 24 references.

29567 **Cenozoic unconformities and depositional supersequences of North Atlantic continental margins: testing the Vail model.** Poag, C.W.; Ward, L.W. (Geological Survey, Woods Hole, MA (USA)). *Geology;* **15**: No. 2, 159-162(Feb 1987).

Integrated outcrop, borehole, and seismic reflection stratigraphy from the US and Irish margins of the North Atlantic basin reveals a framework of Cenozoic depositional supersequences and interregional unconformities that resembles the Vail depositional model. Paleobathymetric and paleoceanographic analyses of associated microfossil assemblages indicate a genetic link between the depositional framework and the relative position of sea level.

29568 **Ellesmerian (?) and Brookian deformation in the Franklin Mountains, northeastern Brooks Range, Alaska, and its bearing on the origin of the Canada Basin.** Oldow, J.S.; Ave Lallemant, H.G.; Julian, F.E.; Seidensticker, C.M. (Rice Univ., Houston, TX (USA)). *Geology;* **15**: No. 1, 37-41(Jan 1987).

Structural analysis of deformed rocks in the Franklin Mountains, northeastern Alaska, indicates that (1) pre-Carboniferous rocks were transported southeastward during mid-Devonian (Ellesmerian?) thrusting, (2) Cretaceous and older rocks were transported northward during Mesozoic-Cenozoic Brookian thrusting, and (3) the pre-Carboniferous rocks were strongly involved in the Brookian deformation. The strong involvement of these rocks in Brookian structures suggests that the magnitude of northward thrusting during Brookian tectonism is virtually uniform from west to east along the axis of the Brooks Range fold and thrust belt. In addition, the newly recognized southern vergence of pre-Carboniferous structures is comparable with that of coeval structures exposed in Arctic Canada to the east. These data are not easily reconciled with the orocline model for the origin of the Canada Basin but are consistent with left-lateral transport on a north-south-striking transform fault along the Canadian Arctic islands. 19 references.

29569 **DOSECC Continental Scientific Drilling Program.** *Earthquakes and Volcanoes;* **19**: No. 2, 48-55(1987).

Deep Observation and Sampling of the Earth's Continental Crust (DOSECC, for short) is a nonprofit corporation, currently composed of 41 member universities, that was founded to manage continental Scientific Drilling Programs somewhat as Joint Oceanographic Institutions (JOI), Inc., manages the Ocean Drilling Program. Funding is provided by the National Science Foundation, with additional support from the US Geological Survey (USGS) and the Department of Energy (DOE). DOSECC currently has two projects in actual operation and several under development. The long-term DOSECC program can be separated into categories based either on drilling depth or on objectives. The first category consists of shallow- to intermediate-depth drilling (up to about 5 km) designed to attain targets related to a better understanding of active processes in the continental crust. The second category of targets push the limit of drilling technology in terms of depth and sometimes with respect to temperature, pressure, and/or corrosive fluid environments. Ultimately DOSECC drilling projects are expected to achieve depths exceeding 15 km. Such ultradeep holes will not only examine dynamic processes in the crust but will also explore crustal history, structures, and conditions at depth. Current budgets allow the drilling of projects in the first category, and planning for eventual deeper drilling at a number of locations is in progress. This paper describes the first hole in the DOSECC program that is presently being drilled at Cajon Pass on the San Andreas fault near San Bernardino in central California.

5802 Geophysics

REFER ALSO TO CITATION(S) 28912, 29314, 29569

29570 **(DOE/ER/13320—1) Drilling investigation of a young magmatic intrusion beneath the Inyo Domes, Long Valley, California: Structural and textural studies:.** Fink, J. (Arizona State Univ., Tempe (USA)). Nov 1987. Contract FG02-85ER13320. 11p.

The purpose of this project was to characterize the geometry and emplacement mechanisms of silicic dikes beneath the Inyo Domes, California. The investigation involved surface structural and textural studies in the Inyo area, mapping projects in analogous areas that offered better controls on either the three-dimensional geometry or emplacement conditions of dikes, and analytical studies of drill core samples. Mapping of structures on and around the Domes suggested that they were fed by an echelon arrangement of rotated dike segments, as later confirmed by the drill cores, and that the dike propagated obliquely to the north. A model was derived relating dike segmentation to changes in host-rock rheology and fracture behavior, rather than to variations in principle stress orientations. Studies of eroded volcanoes showed that the rotation of segments and host-rock brecciation both increase as a dike approaches the surface. SEM and isotopic studies of drill cores led to a model for volatile migration within advancing silicic flows which predicts that explosive hazards associated with these flows may increase as the flow gets farther from its vent. A new model for selective withdrawal from a stratified dike explained observed compositional and textural variations within and among the three Inyo Domes. 11 refs.

29571 **Characterization of Appalachian faults.** Hatcher, R.D. Jr.; Odom, A.L.; Engelder, T.; Dunn, D.E.; Wise, D.U.; Geiser, P.A.; Schamel, S.; Kish, S.A. (Univ. of Tennessee, Knoxville (USA)). *Geology;* **16**: No. 2, 178-181(Feb 1988). Contract AC05-84OR21400.

This study presents a classification/characterization of Appalachian faults. Characterization factors include timing of movement relative to folding, metamorphism, and plutonism; tectonic position in the orogen; relations to existing anisotropies in the rock masses; involvement of particular rock units and their ages, as well as the standard Andersonian distinctions. Categories include faults with demonstrable Cenozoic activity, wildflysch-associated thrusts, foreland bedding-plane thrusts, premetamorphic to synmetamorphic thrusts in medium- to high-grade terranes, postmetamorphic thrusts in medium- to high-grade terranes, thrusts rooted in Precambrian basement, reverse faults, strike-slip faults, normal (block) faults,

compound faults, structural lineaments, faults associated with local centers of disturbance, and geomorphic (nontectonic) faults.

29572 **Flow patterns of magma in dikes, Makhtesh Ramon, Israel.** Baer, G.; Reches, Z. (Geological Survey of Israel, Jerusalem). *Geology;* **15**: No. 6, 569-572(Jun 1987). Contract FG02-85ER13320.

Directions of magma flow were measured in a system of radial dikes in Makhtesh Ramon, Israel. The flow directions were determined from field observations of segments, fingers, grooves, and groove molds of the dikes. The study indicates that the mean axis of magma flow is subhorizontal toward the north, in agreement with the direction of divergence of the radial dike system. Two modes of flow were observed: (1) regular, bedding-parallel flow in the well-stratified rock units and (2) irregular, meandering flow in the massive rock units. It is suggested that corrugated dike walls in well-stratified host rocks cause magma channelization, and random or self-generated restrictions in massive host rocks cause the apparent meanders. Furthermore, the major lithologic boundaries in the host units strongly affect segmentation of the dikes.

29573 **Crustal subdivisions of the eastern and central US and a seismic boundary hypothesis for eastern seismicity.** Hatcher, R.D. Jr.; Zietz, I.; Litehiser, J.J. (Univ. of Tennessee, Knoxville (USA)). *Geology;* **15**: No. 6, 528-532(Jun 1987). Contract AC05-84OR21400.

Potential field and surface geologic data may be used to subdivide the Precambrian and Phanerozoic crust of the eastern and central US into several blocks. These subdivisions are made by using the trends, amplitudes, and frequencies of magnetic anomalies in conjunction with gravity and surface geological data. Most blocks appear unrelated to historical seismicity, but between New Mexico and Georgia, the edges of several blocks may be connected to form the northern boundary of a broad zone of very low earthquake activity. The authors speculate that this southern zone has been decoupled from the stress regime affecting the remainder of the central and eastern US and should experience few, if any, large earthquakes in the future as long as the present stress configuration is maintained.

29574 **Stratigraphic, sedimentologic, and petrologic record of late Miocene subsidence of the central Oregon High Cascades.** Smith, G.A.; Snee, L.W.; Taylor, E.M. (Oregon State Univ., Corvallis (USA)). *Geology;* **15**: No. 5, 389-392(May 1987).

Pliocene to Holocene volcanics of the central Oregon High Cascades, largely confined to an intra-arc graben, bury older volcanic centers. Early High Cascade volcanism is recorded by late Miocene volcanics and sediments of the Deschutes formation that accumulated in a fluvial basin east of the Cascades. Aggradation in the adjacent fluvial basin occurred episodically when pyroclastic debris choked streams. Deschutes basin aggradation commenced near 7.4 Ma and was synchronous with extension-influenced Cascade magmatism dominated by basalts and basaltic andesites. Initial subsidence of the Cascades occurred at about 5.4 Ma in response to plate-margin processes. Structural isolation of the basin from ignimbrites and volcanism-induced sedimentation resulted in widespread development of superimposed paleosols in the basin. Subsequent mafic lavas erupted near the eastern margin of the initial depression were truncated by east-stepping, down-to-the-west faults at about 5.3 Ma.

29575 **Constraints on magma ascent, emplacement, and eruption: geochemical and mineralogical data from drill-core samples at Obsidian dome, Inyo chain, California.** Vogel, T.A.; Younker, L.W.; Schuraytz, B.C. (Michigan State Univ., East Lansing (USA)). *Geology;* **15**: No. 5, 405-408(May 1987). Contract FG02-85ER13321.

Systematic chemical and mineralogical variability occurs in samples from drill holes through Obsidian dome, the conduit to the dome, and a nearby associated feeder dike. The drill-hole samples from the margins of the conduit and most of the lower part of the dome are high-Ba, low-silica rhyolites; they contain two populations of phenocrysts and represent commingled magmas, whereas samples from the dike and upper parts of the dome are low-Ba, higher silica rhyolites that do not reflect commingled magmas. Samples from the center of the conduit are low-Ba, higher silica rhyolites that are only slightly mixed. A major part of the variability within the drill-core samples of the dome and conduit reflects the juxtaposition and commingling of two distinct magmas during their passage through the conduit.

5803 Mineralogy, Petrology, And Rock Mechanics

REFER ALSO TO CITATION(S) 29170, 29248

29576 **(DOE/ER/13416—3) Geochemistry and origin of regional dolomites: Annual progress report, July 26, 1987-March 15, 1988.** Hanson, G.N.; Meyers, W.J. (State Univ. of New York, Stony Brook (USA)). Mar 1988. Contract FG02-85ER13416. 60p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88007347/JAW.

This progress report covers accomplishments over the past year. Over the past year we have continued to maintain a group of excellent graduate students working on petrology of dolomites and closely allied topics. The research topics include: (1) U-Th-Pb systematics in Burlington-Keokuk carbonates;(2) solid inclusions and non-carbonate phases in dolomites of the Burlington-Keokuk FMS;(3) Porosity and permeability in dolomites of Burlington-Keokuk FMS;(4) X-ray microprobe analysis of trace elements using synchroton radiation;(5) Dolomitization of Devonian reef complexes Canning basin western Australia;(6) Quantitative modeling of major and trace elements and isotopes during carbonate diagenesis;(7) Modeling of regional fluid flow;and (8) Stable isotope geochemistry and cathode luminescence of crinoids from the Burlington-Keokuk FMS.

5804 Geochemistry

REFER ALSO TO CITATION(S) 29575, 29576

29577 **Preferential leaching and natural annealing of alpha-recoil tracks in metamict betafite and samarskite.** Lumpkin, G.R.; Ewing, R.C.; Eyal, Y. (Department of Geology, University of New Mexico, Albuquerque, New Mexico 87131). *Journal of Materials Research;* **3**: No. 2, 357-368(Mar 1988).

Leaching experiments on naturally occurring, metamict betafite and samarskite minerals in a bicarbonate--carbonate solution show strongly enhanced release to the solution of short-lived /sup 228/Th relative to its parent isotope /sup 232/Th (by a factor of 3 to 6), but only slightly enhanced dissolution (by a factor of 1.2 to 2) of long-lived /sup 234/U and /sup 230/Th relative to /sup 238/U and /sup 232/Th, respectively. The betafite (a complex Ca--U--Ti--Nb oxide of the pyrochlore group, A/sub 2-//sub m/B/sub 2/X/sub 6/Y/sub 0-1/xH/sub 2/O) and samarskite (a complex Y--Fe--U--Nb oxide with varying stoichiometry between ABO/sub 4/ and AB/sub 2/O/sub 6/) are x-ray and electron diffraction amorphous having experienced doses of 2.2--2.8 x 10/sup 17/ alpha-decay events/mg (24--31 dpa) and 3.8--4.4 x 10/sup 17/ alpha-decay events/mg (39--45 dpa), respectively. The isotopic fractionation is attributed to the radiation damage created by the alpha-decay events. Individual alpha-recoil tracks are preserved for some time as disordered regions of higher chemical reactivity in already fully damaged, aperiodic areas that result from the alpha-decay events. The annealing time of the alpha-recoil track within the aperiodic atomic array of the metamict state is calculated to be 29,300 +- 8100 years for samarskite and 42,700 +- 13,700 years for the betafite. These data plus data on an earlier studied betafite sample (annealing time = 2000 +- 1300 years) give an average annealing time of 25,000 +- 21,000 years.

64 PHYSICS I

6401 Astrophysics And Cosmology

REFER ALSO TO CITATION(S) 29599, 29691

29578 (FNAL/Pub—88/19-A) Quark core stars, quark stars and strange stars. Grassi, F. (Fermi National Accelerator Lab., Batavia, IL (USA)). Jan 1988. Contract AC02-76CH03000. 38p.

A recent one flavor quark matter equation of state is generalized to several flavors. It is shown that quarks undergo a first order phase transition. In addition, this equation of state depends on just one parameter in the two flavor case, two parameters in the three flavor case, and these parameters are constrained by phenomenology. This equation of state is then applied to the hadron-quark transition in neutron stars and the determination of quark star stability, the investigation of strange matter stability and possible strange star existence. 43 refs., 6 figs.

29579 (FRCEA-TH—55) Isotope composition of the high energy cosmic radiation in HEA03-C2, and propagation in view of interstellar helium. Grimtel, a telescope for high energy gamma radiation study, test-experiment in accelerator and numerical simulation. Ferrando, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France); Paris-7 Univ., 75 (France)). Nov 1987. 205p. (In French). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88753366/JAW.

Isotope composition determination of cosmic radiation at 3 GeV/nucleon from HEAO3-C2 data is presented. Isotope separation results from cosmic radiation filtering by geomagnetic field, which allows preferential penetration in magnetosphere for isotopes with the highest ratio A/Z. Then momentum resolution variation with incident nucleus charge is well taken in account. Simultaneous analysis of the two ratios B/C and Sc-Mn/Fe allows the study of cosmic radiation range distribution in the galaxy. A first set of data on reaction cross section of C, O, Fe + alpha has been got. From these data, a simple analytical formula which relates cross sections in helium and in hydrogen is proposed. Interstellar helium influence on cosmic radiation propagation has been studied realistically. And a gamma instrument is presented which covers the 1-100 GeV energy range with a very good angular resolution. Characteristics are estimated. The test-experiment presented is set into a 500 MeV gamma beam. Cherenkov image characteristics are identified and angular resolution is estimated. A numerical simulation is developed.

29580 (IC—87/181) Cosmology in an N-dimensional vector space. Tauber, G.E. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702550/JAW.

Previous results on a Geometrical Foundation for a Unified Field Theory are applied to the expanding universe. In the internal space the metric is chosen so that the curvature invariant depending on the internal variables is a constant (multiplied by a parameter depending on the space time variables), while the corresponding metric in the tangent space is that for a Friedmann universe of constant spatial curvature. The extra parameter is then determined from the consistency relations of the curvatures in the two spaces. Matter distributions can be taken into account by introducing a pressure p and density rho connected by an equation of state, such as p ~ rho. The codetermined equations for fields arising from geometrical considerations and for the radial scale function have been solved in the particular caser of the field for a scalar meson, providing a possible source for the inflatory universe. (author). 12 refs.

29581 (IFT-P—24/87) Qualitative and numerical study of Bianchi IX Models. Francisco, G.; Matsas, G.E.A. (Instituto de Fisica Teorica, Sao Paulo (Brazil)). 1987. 27p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702561/JAW.

The qualitative behaviour of trajectories in the Mixmaster universe is studied. The Lyapunov exponents computed directly from the differential equations and from the Poincare map are shown to be different. A detailed discussion of the role of these exponents in analysing the effect of chaos on trajectories is presented.

29582 (INIS-SU—25/A) Probable locations of extraterrestrial civilizations. Arkhipov, A.V. (AN Ukrainskoj SSR, Kharkov. Inst. Radiofiziki i Ehlektroniki). 1986. 14p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702605/JAW.

The search for extraterrestrial civilizations by their continuous isotropic radioemission at the frequencies from 10^2 to 10^3 MHz is discussing. It is shown, what is a possible appearance of extraterrestrial civilization, which is accessible by modern means from the distance ~ 20 pc at this frequency range. The search for similar radio-sources has been realized. Fortunately the such objects was displaied in the vicinities of the four solar-type stars, which are favourable for intelligence life. The probability of accidental projection of the radio-sources in vicinities of four such stars is only $2x10^{-4}$. These four stars are the promising objects for SETI. Preprint-303; 35 refs.; 3 tabs.

29583 (KFKI—1987-75/C) Rotation of P/Halley. Sagdeev, R.Z.; Szegoe, K.; Kondor, A.; Merenyi, E.; Smith, B.A.; Larson, S.; Toth, I. (AN SSSR, Moscow. Inst. Yadernykh Issledovanij; Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics; Arizona Univ., Tucson (USA). Lunar and Planetary Lab.; Magyar Tudomanyos Akademia, Budapest. Csillagvizsgalo Intezete). (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Nov 1987. 25p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702606/JAW.

The nucleus of the comet Halley rotates as a slightly asymmetric top, the orientation of the rotation axis (the orientation of the angular momentum vector) is b=54 deg +-15 deg, l=219 deg +-15 deg in the ecliptic system. In the case of the rotation of an asymmetric top the rotation axis is not fixed rigidly to the body, which means that while the nucleus rotates around the axis with a period of 2.2+-0.05 d, its long axis 'nods' periodically with a period of 7.4+-0.05 d. The amplitude of the 'nodding' is about 15 deg +-3 deg in both directions relative to a plane perpendicular to the rotation axis. (author) 21 refs.; 6 figs.; 2 tabs.

29584 (N—88-17572) Data reduction and analysis of HELIOS plasma wave data. Final technical report, 1 June 1985-31 May 1987. Anderson, R.R. (Iowa Univ., Iowa City (USA)). Mar 1988. 7p. (NASA-CR—182466; NAS—1.26:182466). NTIS, PC A02/MF A01.

Reduction of data acquired from the HELIOS Solar Wind Plasma Wave Experiments on HELIOS 1 and 2 was continued. Production of 24 hour survey plots of the HELIOS 1 plasma wave data were continued and microfilm copies were submitted to the National Space Science Data Center. Much of the effort involved the shock memory from both HELIOS 1 and 2. This data had to be deconvoluted and time ordered before it could be displayed and plotted in an organized form. The UNIVAX 418-III computer was replaced by a DEC VAX 11/780 computer. In order to continue the reduction and analysis of the data set, all data reduction and analysis computer programs had to be rewritten.

29585 (N—88-18540) Extended atmospheres of outer planet satellites and comets. Interim report, 15 June-14 September 1987. Smyth, W.H.; Combi, M.R. (Atmospheric and Environmental Research, Inc., Cambridge, MA (USA)). Nov 1987. 122p. (NASA-CR—181449; NAS—1.26:181449). NTIS, PC A06/MF A01.

A major model documentation paper for cometary gas coronae and a second paper successfully applied the model to simulate the hydrogen Lyman-alpha coma of comet Kohoutek were completed and are discussed. New and very exciting data for the hydrogen distribution in the Saturn system obtained form earlier unreduced Voyager 1 and Voyager 2 data are preliminarily reviewed. This new data opens up a whole new series of investigations and indicate that Saturn's corona plays a major role in supplying hydrogen to the circumplanetary volume.

29586 **(PB—88-170881/XAB) Table of solar activity associated with coronal mass ejections observed by the SMM coronagraph/polarimeter in 1980. Technical note.** Webb, D.F. (National Center for Atmospheric Research, Boulder, CO (USA)). Oct 1987. 41p. (NCAR/TN—297-STR). NTIS, PC A03/MF A01.

This report is the description and presentation of a table of solar activity considered to be associated with coronal mass ejections (CMEs) as observed during 1980 with the High Altitude Observatory's Coronagraph/Polarimeter (C/P) on the SMM spacecraft. The list has formed the basic data set for several studies, most prominently a study of CME associations published by Webb and Hundhausen (1987). An attendant source of CME data is the unpublished C/P Event List for 1980, which co-evolved with the association list under the guidance of Art Hundhausen. Discussions of the details of the selection and verification of the list of SMM CMEs are contained in the above paper as well as in this papers of Hundhausen et al. (1984) and Hundhausen (1987).

29587 **Remarks on the first two events in the supernova burst observed by Kamiokande II.** Rosen, S.P. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] D: Particles and Fields;* **37**: No. 6, 1682-1684(15 Mar 1988). Contract W-7405-ENG-36.

We examine the possibility, remote but not totally improbable, that one of the first two supernova events observed in the Kamiokande II detector consists of an electron neutrino scattering from an electron. From arguments of timing we show that this possibility can be realized only for the first event, and that it requires the electron-neutrino mass to be less than 2.5 eV. The occurrence of such an event means that, of the various Mikheyev-Smirnov-Wolfenstein solutions to the solar-neutrino problem, the nonadiabatic one is likely to be correct.

29588 **Hyper-velocity and tidal stars from binaries disrupted by a massive Galactic black hole.** Hills, J.G. (Los Alamos National Lab., NM (USA)). *Nature (London);* **331**: No. 6158, 687-689(25 Feb 1988).

A close but newtonian encounter between a tightly bound binary and a 10^6 M solar mass black hole causes one binary component to become bound to the black hole and the other to be ejected at up to 4,000 km s^{-1}. The discovery of even one such hyper-velocity star coming from the Galactic centre would be nearly definitive evidence for a massive black hole. The new companion of the black hole has a high orbital velocity which increases further as its orbit shrinks by tidal dissipation. The gravitational energy released by the orbit shrinkage of such a tidal star can be comparable to its total nuclear energy release.

29589 **Lyman-alpha clouds as a relic of primordial density fluctuations.** Bond, J.R.; Szalay, A.S.; Silk, J. (Toronto Univ. (Canada); NASA/Fermi National Accelerator Laboratory, Batavia, IL (USA); Eotvos Lorand Tudomanyegyetem, Budapest (Hungary); California Univ., Berkeley (USA)). *Astrophysical Journal;* **324**: 627-638(Jan 1988).

Primordial density fluctuations are studied using a CDM model and primordial clouds some of which are expanding, driven by pressure gradients created when the medium is photionized, and some of which are massive enough to continue collapsing in spite of the pressure. Normalization of CDM models to the clustering properties on large scales are used to predict the parameters of collapsing clouds of subgalactic mass at early epochs. It is shown that the abundance and dimensions of these clouds are comparable to those of the Lyman-alpha systems. The evolutionary history of the clouds is computed, utilizing a spherically symmetric hydrodynamics code with the dark matter treated as a collisionless fluid, and the H I column density distribution is evaluated as a function of N(H I) and redshift. The observed cloud parameters come out naturally in the CDM model and suggest that Lyman-alpha clouds are the missing link between primordial density fluctuations and the formation of galaxies. 31 references.

29590 **LkH-alpha 101 - the stellar wind, the surrounding nebula, and an associated radio star cluster.** Becker, R.H.; White, R.L. (California Univ., Davis (USA); Lawrence Livermore National Lab., CA (USA); Space Telescope Science Institute, Baltimore, MD (USA)). *Astrophysical Journal;* **324**: 893-898(Jan 1988).

Radio observations of LkH-alpha 101 have been taken to determine the characteristics of the stellar wind from the central star as well as to image the surrounding nebulosity. They also revealed the presence of a high concentration of weak compact radio sources in the neighborhood of LkH-alpha 101, four of which have optical stellar counterparts. Spectra of three of the stars indicate two T Tauri stars and a highly obscured B star. 15 references.

29591 **Theoretical interpretations of anomalous Cepheid pulsations.** Cox, A.N.; Proffitt, C.R. (Los Alamos National Lab., NM (USA); Washington Univ., Seattle (USA)). *Astrophysical Journal;* **324**: 1042-1047(Jan 1988).

Detailed pulsation studies have been made of five anomalous Cepheids in the Draco galaxy, one in the galactic globular cluster NGC 5466 and a possible anomalous Cepheid in M15. Observed quantities are periods, luminosities, and effective temperatures. Pulsation masses range from 1.0 to 1.8 solar masses, as found by others before. The variables with effective temperatures above 7000 K seem to be in the first overtone radial mode, while the others are fundamental pulsators. Investigations show that the masses and pulsation modes are independent of the assumed composition and details of the convection such as inclusion of the considerable turbulent pressure as part of the total pressure in the convection zone. 19 references.

29592 **Dark matter, galaxies and large-scale structure in the Universe.** Primack, J.R. (Stanford Linear Accelerator Center, CA (USA)). pp v of Elementary particles. Proceedings. Cabibbo, N. (ed.). Amsterdam, Netherlands; North-Holland (1987). (CONF-8406212—).

From International school of physics "Enrico Fermi"; Varenna, Italy (18 Jun 1984).

The present lectures take a different approach, emphasizing the period after the first three minutes, during which the Universe expands by a factor of $\simeq 10^8$ to its present size, and all the observed structures form. This is now an area undergoing intense development in astrophysics, both observationally and theoretically. It is probably now ripe for major progress. It is not impossible that the present decade will see the construction at last of a fundamental theory of cosmology, with perhaps profound implications for particle physics as well. (orig.BBO).

29593 **PIC simulations of electrodynamic models for astrophysical jets.** Gisler, G.R.; Lovelace, R.V.E.; Norman, M.L. (Los Alamos National Lab. (US)). pp 20 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

Both the beam and the electromagnetic flux play roles in the development of inner-core structure in extragalactic radio sources. The relativistic beam gives rise to the VLBI lobes, which often have apparent speeds of separation several times the speed of light, indicating relativistic motion with a component along the line of sight. The Poynting flux interacts with neutral plasma clouds outside the diode, accelerating them to the nonrelativistic bulk speeds inferred for jets outside the VLBI regions. The authors simulated this system using the particle-in-cell plasma code ISIS. The results yield the beam and the Poynting flux, with expected scalings. An unexpected result is that the diode pulses between two modes.

29594 **Cosmology and particle physics.** Steigman, G. (Univ. of Delaware, Newark (USA)). *Revista Mexicana de Astronomia y Astrofisica;* **12**: 21-30(Feb 1986). (CONF-8411206—). Contract AC02-78ER05007.

From 4. International Astronomical Union (IAU) regional meeting; Rio de Janeiro, Brazil (18 Nov 1984).

The Hot Big Bang Cosmology is the generally accepted Standard Model for describing the evolution of the Universe. The reasons for this are clear. The standard model provides a natural framework for understanding - quantitatively as well as qualitatively - the observed expansion of the Universe. The Hot Big Bang Model also accounts for the thermal spectrum of the microwave background radiation. Finally, element synthesis predicted to occur during the early evolution of the Universe in the standard model - Primordial Nucleosynthesis - provides the site for the origin of the light elements in their observed abundances. The successes of the standard model have encouraged them to be bold and forced them to be honest. There are some problems. There are several cosmological puzzles which, until recently, have either been ignored or blamed on (unknowable) boundary or initial conditions. Occasionally, these problems have been solved by appeal to quantum gravity - a theory which, though conceived, is yet to be born. In a tour through the Early Universe the landmarks will be the description of these Cosmological Puzzles and an outline of the solutions which have been proposed via the Particle Physics/Cosmology Connection. The puzzles have been described previously (Steigman 1981, 1984); for a review of the solutions see Turner (1983, 1984) and the Proceedings of the Fermilab Inner Space/Outer Space Workshop (Fermilab, May 1984). 12 references.

6402 Atmospheric Physics

REFER ALSO TO CITATION(S) 29737

29505 (AD-A—188328/9/XAB) Low-energy plasma flows in the CDAW substorm on 22 March 1979. Progress report. Huang, C.Y.; Frank, L.A.; Eastman, T.E. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). Oct 1986. 27p. (U.OF-IOWA—86-47). NTIS, PC A03/MF A01.

The substorm of 22 March 1979 offers a particularly clear example of isolated activity. At the onset at 1054 UT and subsequently, both ISEE spacecraft are located close to both the midplane of the tail and local midnight. Plasma-sheet thinning occurs prior to onset, and at onset strong plasma flows are observed at both ISEE spacecraft. The net flow direction is initially tailward, although there are persistent slow flows directed earthward. Some time later there are strong flows earthward, coincident with plasma sheet recovery. This study focuses on the three-dimensional velocity distributions measured on ISEE 1, in particular the low-energy plasma population that coexists with the energetic streaming plasma.

29506 (AD-A—188919/5/XAB) Assessment of the application of in-situ ion-density data from DMSP to modeling of transionospheric scintillation. Technical report, 15 September 1986-14 September 1987. Secan, J.A. (Northwest Research Associates, Inc., Bellevue, WA (USA)). 15 Sep 1987. 78p. (NWRA-CR—87-R017). NTIS, PC A05/MF A01.

Modern military communication, navigation, and surveillance systems depend on reliable, noise free transionospheric radio-frequency channels. They can be severely impacted by small-scale electron-density irregularities in the ionosphere which cause both phase and amplitude scintillation. Basic tools used in planning and mitigation schemes are climatological in nature and thus may greatly over- and under-estimate the effects of scintillation in a given scenario. This report describes the first year of an investigation into the feasibility of using in-situ observations of the ionosphere from the USAG DMSP satellite to calculate estimates of irregularity parameters that could be used to update scintillation models in near real-time. Methods for calculating estimates of the height-integrated irregularity strength parameter (CkL) from DMSP SSIES data are described, and the results of parametric studies of the effects of errors or uncertainties in both the observed quantities and the methods used to calculate the estimates of CkL are presented.

6403 Atomic, Molecular, And Chemical Physics

REFER ALSO TO CITATION(S) 29758

29597 (CERN-EP—86-192) Cascade of exotic helium atoms. Reifenroether, G.; Klempt, E.; Landua, R. (Mainz Univ. (Germany, F.R.). Inst. fuer Physik). 19 Nov 1986. 7p. (CONF-860977—6).

From Antiproton '86: European symposium on nucleon-antinucleon interactions; Thessalonika, Greece (1 Sep 1986).

The cascade of μ-^{4}He, anti p-^{4}He, anti p-^{3}He and its pressure dependence has been calculated over the whole pressure range from 1×10^{-2} atm to 1×10^3 atm. The calculation does not use any free parameter. The results agree reasonably well with experimental data. 15 refs., 3 figs.

29598 (DOE/ER/13394—T1) Studies of autoionizing states relevant to dielectronic recombination:. Gallagher, T.F. (Virginia Univ., Charlottesville (USA). Dept. of Physics). Jan 1988. Contract FG05-85ER13394. 22p.

This report describes the experimental studies carried out under DOE Grant DEPG05-85ER13394. They are the studies of the Sr 5pns and 5pnd states in which the total autoinization rates and interseries interaction have been determined, investigations of the angular and energy distributions of electrons ejected from the Sr 5pns states, the investigation of a selective ionization schene for Ryberg atoms, the measurement of autoionization rates of the Ba 6pnl states for high l, the effects of microwave fields on autoionization, and finally forces autoionization. In the body of the report we provide a summary of each of these projects. The details are provided in the appendices, which are reprints of published papers describing the work. 21 refs., 8 figs.

29599 (DOE/ER/13442—T1) Energy-transfer properties and mechanisms:. Barker, J.R. (Michigan Univ., Ann Arbor (USA). Dept. of Atmospheric, Oceanic and Space Science). Feb 1988. Contract FG02-85ER13442. 18p. Q 03/MF A01;1; GPO Dep. Order Number DE88007107/JAW.

This project continues the research on vibrational energy transfer involving large molecules. The motivation of the research is to advance knowledge concerning molecular energy in the electronic ground state so that meaningful predictions can be made. The experimental program will use several techniques on several different molecules with the aim of eliminating experimental artifacts and gaining more insight into energy transfer processes. The theoretical effort will be directed toward assessing the validity of the Biased Random Walk theory and toward developing simpler models that adequately describe the energy transfer process. 6 figs.

29600 (IC—87/72) Density functional theory and electronic structure. Das, M.P. (International Centre for Theoretical Physics, Trieste (Italy)). May 1987. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702507/JAW.

The paper presents an overview of the density functional theory and provides a brief appraisal of the latest developments of the theory. Particular emphasis is placed on the understanding of the electronic structure of materials via the density functional theory. 37 refs, 1 tab.

29601 (IC—87/109) Evidence for laser emission from the TICT exciplex of coumarin dyes. Masilamani, V. (International Centre for Theoretical Physics, Trieste (Italy)). Jun 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702544/JAW.

This paper gives confirming evidence for the possibility of super radiant laser emission from the Twisted Internal Charge Transfer (TICT) conformation in exicted state complexation with the solvent, of coumarin family of laser dyes. (author). 6 refs, 1 fig., 2 tabs.

29602 **(IC—87/111) Photofragmentation of water and hydrogen sulphide in the first continuum: A critical survey.** Mohamed, K.A. (International Centre for Theoretical Physics, Trieste (Italy)). Jun 1987. 15p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702545/JAW.

Photofragmentation of H_2O and H_2S in the first absorption continuum has been investigated experimentally and theoretically by several authors. The fragmentation dynamics of both molecules are reviewed in this article. While the excited $^1B_1$ state in H_2O is responsible for the first continuum, ambiguity exists in the true nature of the upper state of the first continuum in H_2S. From the evidence available so far, it is proposed that both in water and hydrogen sulphide, a single state of B_1 symmetry, which is of Rydberg type for short internuclear distances and of valence type for large internuclear distances, is the possible upper state which dissociates to produce the absorption continuum. (author). Refs.

29603 **(LA—10958-MS) Arcing and rf signal generation during target irradiation by a high-energy, pulsed neutral particle beam.** Robiscoe, R.T. (Los Alamos National Lab., NM (USA)). Feb 1988. Contract W-7405-ENG-36. 81p.

We present a theory describing the dynamics of arc discharges in bulk dielectric materials on board space-based vehicles. Such "punch-through" arcs can occur in target satellites irradiated by high-energy (250 MeV), pulsed (100 mA x 10 ms) neutral particle beams. We treat the arc as a capacitively limited avalanche current in the target dielectric material, and we find expressions for the arc duration, charge transport, currents, and discharge energy. These quantities are adjusted to be consistent with known scaling laws for the area of charge depleted by the arc. After a brief account of the statistical distribution of voltages at which the arc starts and stops, we calculate the signal strength and frequency spectrum of the electromagnetic radiation broadcast by the arc. We find that arcs from thick ({similar←to}1 cm) targets can generate rf signals detectable up to 1000 km from the target, bu a radio receiver operating at frequency 80 MHz, bandwidth 100 kHz, and detection threshold -105 dBm. These thick-target arc signals are 10 to 20 dB above ambient noise at the receiver, and they provide target hit assessment if the signal spectrum can be sampled at several frequencies in the nominal range 30-200 MHz. Thin-target ({similar←to}1 mm) arc signals are much weaker, but when they are detecable in conjunction with thick-target signals, target discrimination is possible by comparing the signal frequency spectra. 24 refs., 12 figs.

29604 **(SAND—88-0039) RADLAC and IBEX studies, 1987.** Poukey, J.W. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1988. Contract AC04-76DP00789. 41p.

During 1987 most of the high-current particle simulation (MAGIC) work was concentrated on diodes, accelerating gaps, and conditioning cells for RADLAC and IBEX. The main new feature was the emphasis on the use of current-carrying wires to guide the electron beams. This report describes the results and some of the implications. 10 refs., 22 figs.

29605 **(UCRL—53852) High-order multiphoton ionization of the noble gases.** Perry, M.D. (Lawrence Livermore National Lab., CA (USA)). Nov 1987. Contract W-7405-ENG-48. 293p. NTIS, PC A13/MF A01;1; GPO Dep. Order Number DE88007489/JAW.

Ionization of an atom by the absorption of several photons from a strong electromagnetic field is considered. Specifically, the absolute yield of multiply charged ions of the noble gases, argon, krypton, and xenon produced using a well-characterized, tunable picosecond dye laser is reported as a function of both laser intensity and frequency. Theoretical models are developed to provide a quantitative interpretation of the data. The experiments were designed to investigate the influence of intermediate atomic states on the multiphoton ionization probability at intensities such that the strength of the applied field approached that of the internal atomic field. This was accomplished by measuring the ion yield over a broad range of laser intensity, $10^{12} \leqq I \leqq 4 \times 10^{14}$ Wcm^2 and frequency. The laser wavelength was varied between 570 and 620 nm and the second harmonic, 285 to 310 nm. Enhancement of the yield of singly-charged krypton ions by two orders of magnitude by three-photon resonant, four-photon ionization was observed at intensities nearly two orders of magnitude above previous results. A model which considers only two atomic levels coupled by the strong field is presented and is found to be in good agreement with the experimental results. Measured values of the three-photon Rabi rate to, and the photoionization cross sections of, several excited states of Kr I are reported. In addition, even at intensities exceeding 10^{13} Wcm^2, it was possible to find frequencies at which no resonant enhancement of the ionization probability could be observed. Charge states as high as Ar^{4+}, Kr^{5+} and Xe^{6+} produced by this nonresonant multiphoton ionization were observed at the highest intensities. 102 refs., 50 figs., 5 tabs.

29606 **Effects of autoionizing resonances on electron-impact excitation rates for Be-like ions.** Chen, M.H.;Crasemann, B. (High Temperature Physics Division, University of California, Lawrence Livermore National Laboratory, Livermore, California 94550). *Physical Review [Section] A: General Physics;* **37**: No. 8, 2886-2892(15 Apr 1988). Contract W-7405-ENG-48.

The effects of autoionizing resonances on the electron-impact excitation rates for n = 2 to n = 2 intrashell transitions in Be-like ions have been studied for six ions with atomic numbers Z = 30, 34, 36, 42, 47, and 54. The resonance contributions to the excitation rates were calculated in the isolated-resonance approximation. Detailed Auger and radiative rates were evaluated in the multiconfiguration Dirac-Fock model. Results are compared with background rates from the Coulomb-Born-exchange approximation. Autoionizing resonance have been found to enhance the electron-impact excitation rates by a factor of 2–4 for the electric-dipole-forbidden transitions, while for dipole-allowed transitions, the resonance effects amount to only a few percent of these rates.

29607 **Two photon spectra of electronic states of Kr_2 and ArKr near the Kr* $4p^5 5p$ states.** Dehmer, P.M.;Pratt, S.T. (Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Chemical Physics;* **88**: No. 7, 4139-4146(1 Apr 1988). Contract W-31-109-ENG-38.

The two photon resonant, three photon ionization spectra of Kr_2 and ArKr were determined in the energy region of the Kr* $5p[32]_1$, $5p[32]_2$, and $5p[12]_0$ states. The spectrum of Kr_2 displays three new band systems that arise from two photon transitions from the ground state to excited states of gerade symmetry. The analysis of the observed vibronic structure of these band systems provides new information on the dissociation energies and the potential energy curves of the low-lying dipole forbidden excited gerade states of Kr_2. A photoelectron spectrum determined following (2+1) excitation via an intense peak of the band system dissociating to Kr $^1S_0$+Kr* $5p[12]_0$ provides the first observation of the weakly bound C $^3Pi_2$/sub u/ state and the repulsive B $^3Pi_1$2/sub g/ and D ^{1}{Sigma}$^+_1$2/sub g/ states of Kr_2. The (2+1) ionization spectra for both ArKr and KrXe were examined in the same energy region. For ArKr, a band system analogous to that observed in Kr_2 was observed near the Kr* $5p[12]_0$ state, and an additional band system was observed near the Ar* $4s[32]^0_1$ state. No structure was observed for KrXe.

29608 **Excited-state dynamics of rare-gas clusters.** Scharf, D.;Jortner, J.;Landman, U. (School of Chemistry, Tel-Aviv University, 69978 Tel-Aviv, Israel). *Journal of Chemical Physics;* **88**: No. 7, 4273-4288(1 Apr 1988).

In this paper we explore the dynamic implications of energy exchange in electronically vibrationally excited states of mixed rare-gas clusters. The classical molecular dynamics method was applied for the study of vibrational energy flow from electronically excited atomic Xe($^3P_1$) states in Xe^*Ar_{12} and Xe^*Ar_{54}, and the consequences of Xe/sup */$_2$ (^{3}{Sigma}/sub u/) excimer formation in Xe/sup */$_2$ Ar_{11} and Xe/sup */$_2$ Ar_{53} clusters. We have established the occurrence of an ultrafast vibrational energy flow ({similar←to}300 fs) from local Rydberg atomic and excimer excitations into the cluster, which is accompanied by large configurational dilation around the excited state, due to short-range repulsive interactions. Size effects on cluster dynamics were elucidated, being manifested by vibrational predissociation in small clusters and by vibrational relaxation and vibrational energy redistribution in large clusters. A gradual transition from reactive molecular type relaxation in small clusters to nonreactive condensed-matter type relaxation in large

clusters was documented. Qualitative and quantitative differences between relaxation of excited species initially located in the interior or on the surface of the cluster were established, being exhibited in the details of the vibrational energy flow. In the case of bulk Xe/sup */s Ar$_{18}$, excessive local heating is manifested in cluster melting, which results in mass transport of the excimer to the cluster surface. The many facets of the dynamics of electronically excited mixed rare-gas clusters are amenable to experimental interrogations.

29609 **Electron energy loss spectroscopy of disilane.** Dillon, M.A.;Spence, D.;Boesten, L.;Tanaka, H. (Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Chemical Physics;* 88: No. 7, 4320-4323(1 Apr 1988). Contract W-31-109-ENG-38.

Electron energy loss spectra of disilane have been recorded over an excitation energy range of 20 eV employing electrons of 20 and 200 eV incident energy for scattering angles of 0°–90°. Every transition detected except one appears at an energy consistent with the first observed members of Rydberg series converging to one of four possible ion states. The first two observed transitions belong to (2a$_1$/sub g/)^2→^{1}/sup ,/^{3}(2a$_1$/sub g/,4s) dipole forbidden channels appearing at excitation energies of {similar←to}6.3 and 7.05 eV for the triplet and singlet, respectively. Evidence is presented for the identification of additional forbidden transitions as well as possible low-lying valence transition.

29610 **Quenching of spontaneous-emission coefficients in plasmas.** Chung, Y.;Lemaire, P.;Suckewer, S. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). *Physical Review Letters;* 60: No. 12, 1122-1125(21 Mar 1988).

We have observed changing Einstein coefficients of spontaneous emission as a function of electron density in CO_2 laser-produced plasmas. These measurements are based on the intensity branching ratio of O IV lines 5801–5812 and 312.41–312.46 A which share a common upper level. Similar observations for O III lines are also discussed.

29611 **Polarization of molecular x-ray fluorescence.** Lindle, D.W.;Cowan, P.L.;LaVilla, R.E.;Jach, T.;Deslattes, R.D.;Karlin, B.;Sheehy, J.A.;Gil, T.J.;Langhoff, P.W. (National Bureau of Standards, Gaithersburg, Maryland 20899). *Physical Review Letters;* 60: No. 11, 1010-1013(14 Mar 1988).

Polarization of Cl Kβ x-ray fluorescence following selective excitation of gaseous CH_3CL with synchrotron radiation is reported. The degree of polarization of the fluorescence depends sensitively on the chosen incident excitation energy in the Cl K-edge region. Theoretical considerations indicate that the fluorescence-polarization measurements can provide directly absorption and emission anisotropies, molecular-orbital symmetries, and relative fluorescence transition strengths.

29612 **Wavelengths and energy levels of I V and I VI.** Kaufman, V.;Sugar, J.;Joshi, Y.N. (Atomic and Plasma Radiation Division, National Bureau of Standards, Gaithersburg, Maryland 20899). *Journal of the Optical Society of America B: Optical Physics;* 5: No. 3, 619-622(Mar 1988).

The spectra of iodine were photographed in the 139–1500-A@;O region on various spectrographs. Earlier analyses of I V and I VI were revised and extended. For I V 26 lines were classified, and for I VI 35 lines were classified. Ionization energies have been estimated to be 415 510 @m≈ 300 cm^{-1} (51.52 @m≈ 0.04 eV) and 599 800 @m≈ 3 000 cm^{-1} (74.37 @m≈ 0.37 eV) for I V and I VI, respectively.

29613 **Study of diacetylene monomer and polymer monolayers using second- and third-harmonic generation.** Berkovic, G.;Superfine, R.;Guyot-Sionnest, P.;Shen, Y.R.;Prasad, P.N. (Department of Physics, University of California Center for Advanced Materials, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Journal of the Optical Society of America B: Optical Physics;* 5: No. 3, 668-673(Mar 1988). Contract AC03-76SF00098.

Monolayers of several diacetylene monomers and polymers spread at the air-water interface have been studied using optical second-harmonic generation (SHG) and third-harmonic generation (THG). Owing to the centrosymmetry of the diacetylene core, SHG from these molecules arises mainly from their side groups. THG from a single monolayer of polydiacetylene is reported, to our knowledge, for the first time: the THG signal (in reflection) arising from the polydiacetylene monolayer is several times larger than that from the water subphase. THG was observed both when a polymer monolayer was spread directly and when a monomer monolayer was UV polymerized on the water surface. Values of the third-order nonlinearity of polydiacetylenes derived from these measurements are in agreement with earlier studies.

29614 **Fine-structure effect for n^{3}L states in LS-coupled targets.** Csanak, G.;Cartwright, D.C.;Blum, K. (Los Alamos National Lab., NM (USA);Muenster Univ. (Germany, F.R.). Inst. fuer Theoretische Physik 1). *changed to JPAMA;* 21: No. 4, L107-L112(28 Feb 1988).

The fine-structure effect associated with electron impact excitation of LS-coupled atomic targets from the ^{1}S ground state to a n^{3}L final state is discussed. The relationship between the electron impact coherence parameters (EICP) and the fine-structure effect spin-polarisation function is illustrated for the case of excitation of the n^{3}Dsub(J) states of helium. It is shown that for L ≧ 3 excitation processes, the electron spin-polarisation experiments provide different information from that obtained from electron-photon coincidence experiments. If data from spin-polarisation and EICP experiments can be combined, information about the octupole moment of the electron impact induced final atomic state can be obtained.

29615 **Energy Levels of Molybdenum, Mo I through Mo XLII.** Sugar, J.;Musgrove, A. (Center for Radiation Research, National Measurement Laboratory, National Bureau of Standards, Gaithersburg, Maryland 20899). *Journal of Physical and Chemical Reference Data;* 17: No. 1, 155-239(Jan 1988).

The energy levels of the molybdenum atom, in all stages of ionization for which experimental data are available, have been compiled. Ionization energies, either experimental or theoretical, and experimental g-factors are given. Leading components of calculated eigenvectors are listed.

29616 **Collision frequencies for screened Coulomb psuedopotentials of ionic sodium.** Kinser, H.B.; Crawford, O.H. (Dalton Junior College, GA (USA)). *Georgia Journal of Science;* 45: No. 2, 89(1987).

The modified Coulomb psuedopotentials for sodium, which gave good descriptions of the bound state energies as given last year at the GAS meeting, were used to determine to collision frequencies for the low energy scattering of electrons from the sodium ion in a condensed state. The potentials were exponentially screened and the differential equations solved numerically, allowing the evaluation of the scattering phase shifts necessary for the collision frequency determinations. The results for the screened psuedopotentials of Abarenkov and Heine gave good agreement with the quite different one of Cohen.

29617 **Models for the transport of low energy electrons in water and the yield of hydrated electrons at early times.** Brenner, D.J.;Miller, J.H.;Ritchie, R.H.;Bichsel, H. (Columbia Univ., New York, NY). pp v of Thirty-third annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1985). (CONF-8505113—).

From 33. annual scientific meeting of the Radiation Research Society; Los Angeles, CA, USA (5 May 1985).

An insulator model with four experimental energy bands was used to fit the optical properties of liquid water and to extend these data to non-zero momentum transfer. Inelastic mean free paths derived from this dielectric response function provided the basic information necessary to degrade high energy electrons to the subexcitation energy domain. Two approaches for the transport of subexcitation electrons were investigated. (i) Gas phase cross sections were used to degrade subexcitation electrons to thermal energy and the thermalization lengths were scaled to unit density. (ii) Thermalization lengths were estimated by age-diffusion theory with a stop-

ping power deduced from the data on liquid water and transport cross sections derived from elastic scattering in water vapor. Theoretical ranges were compared to recent experimental results. A stochastic model was used to calculate the rapid diffusion and reaction of hydrated electrons with other radiolysis products. The sensitivity of the calculated yields to the model assumptions and comparison with experimental data are discussed.

6404 Fluid Physics

REFER ALSO TO CITATION(S) 29593

29618 **(LNCC—018/86) Condensate fraction in superfluid ^{4}He.** Olinto, A.C. (Laboratorio Nacional de Computacao Cientifica, Rio de Janeiro (Brazil)). 1986. 20p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702610/JAW.

Recently, a relationship between the chemical potential and the condensate fraction eta/sup o/ (T) has been derived for all temperatures in the superfluid region. An analysis of liquid ^{4}He chemical potential data yields eta/sup o/ (T=0) = 0.062 and eta/sup o/ (T) is in excellent with the empirical results of Svensson, Sears, and Griffin. (Autor).

29619 **(TRITA-PFU—86-09) Incompressible LFR MHD. A fluid model for stability analysis of a fusion plasma.** Scheffel, J.; Faghihi, M. (Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics and Fusion Research). Oct 1986. 39p. NTIS (US Sales Only), PC A03/MF A01 - Also available from: Royal Inst. of Techn., Stockholm (Sweden).. Order Number DE88753318/JAW.

A fluid model including FLR effects, named Incompressible Finite Larmor Radius MagnetoHydroDynamics, is presented and derived in this paper. It is an extension of ordinary, incompressible MHD to include the Larmor radius effects due to ion gyroviscosity, Hall current and electron diamagnetism. It is intended to use the model for stability analysis, on the Alfven wave time scale, of a fusion plasma and it is consequently based on transport coefficients in the collisionless limit. It will be demonstrated that for a fairly dense and cool plasma, such as for the EXTRAP z-pinch, all three Larmor radius effects may become important, that for a JET-type plasma no FLR effect is pronounced, and that in a reactor plasma the Hall and electron diamagnetism term may play a role. For scaling lengths signigicantly smaller than the plasma radius the effect of the FLR terms becomes enhanced. To study the importance of the choice of equations of state for the model the m=1 and k/sup 2/τ/sup 2/ towards infinity instability in cylindrical geometry is given special attention for zero Larmor radius. The full stability criterion of the double adiabatic model, including pressure anisotropy, is presented for what we believe to be the first time. It is found that when perpendicular p > parallel p stability can be reached for very high plasma perpendicular β-values. We demonstrate that no less complicated energy conserving fluid model, which takes into account pressure anisotropy, other than the double adiabativ model can be obtained. Since pressure anisotropy generally only weakly affects stability, we can assume isotropy in the Incompressible FLR MHD model. Also, the energy equation is replaced by the incompressibility condition, making FLR terms appearing in the energy equation irrelevant. (authors).

29620 **(UCID—20297-87-3) LLNL granular solids flow project: Quarterly report, July-September 1987.** Walton, O.R. (ed.). (Lawrence Livermore National Lab., CA (USA)). Oct 1987. Contract W-7405-ENG-48. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88007492/JAW.

Research under this project has emphasized the study of rapid shearing flows of dry, cohesionless granular solids. This is a first step toward developing a more general understanding of multiphase, solids containing flows under a wide range of flow conditions. During this period we extended the range of parameters examined in our study of steady shearing flows of inelastic, frictional spheres, determining the effect of friction coefficient and particle stiffness on stresses at various solids packing fractions. We found that stresses for smooth (frictionless) spheres increased as the effective stiffness of the particles increased, while stresses in systems of frictional spheres decreased as the stiffness increased. Available volume and effective contact duration arguments appear to explain the observed effects. We also added an approximate air-drag algorithm to the 3DSHEAR model and performed further simulation calculations of previously described channel flow experiments. Inclusion of the air-drag term significantly improved the correlation between simulated and measured velocity profiles;however, some discrepancies remain. Further calculations are planned to examine sensitivity of the results to various parameters, including the friction coefficient of the glass side walls and the channel width. During this period two new areas of study were also initiated. In anticipation of future simulation calculations of quasi-static deformations which may require more exact descriptions of friction forces, a detailed examination of contact friction models was started. The other new area of study is an examination of methods of calculating hydrodynamic forces acting on spherical particles in suspension, leading eventually to methods of calculating viscosities of suspensions and slurries.

29621 **Thermal-accommodation measurement of helium on a suspended water droplet.** Fung, K.H.;Tang, I.N. (Environmental Chemistry Division, Department of Applied Science, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] A: General Physics;* **37**: No. 7, 2557-2561(1 Apr 1988). Contract AC02-76CH00016.

An innovative method for determining the thermal-accommodation coefficients of gases by means of monitoring the Mie scattering from a single suspended water droplet is described. The heat exchange between the gas molecules and the suspended droplet is analyzed by considering the simultaneous mass- and heat-transfer processes during droplet growth by condensation in a gas--water-vapor environment. Measurements have been carried out for helium with water-vapor-to-helium ratios in the range of 1:0.5 to 1:2.5. The thermal conductivity of this mixture is found to be best represented by its reciprocal average. The thermal-accommodation coefficient of helium on water surfaces is determined to be 0.65 +- 0.05, as compared to unity for water vapor on water surfaces.

29622 **Ideal water waves via instantaneous action at a distance.** Crawford, F.S. (Physics Department and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *American Journal of Physics;* **56**: No. 4, 300-303(Apr 1988).

An elementary derivation is given of the kinematics and dynamics of small amplitude sinusoidal water waves in deep water, using, for the kinematics, a "Green's function integral" approach having intuitive appeal. At first, the usual simplifying assumption of incompressible water is made and the standard results are obtained. Then the approach is found to lend itself to the calculation of small corrections due to finite compressibility.

29623 **Application of lattice-gas cellular automata to the Brownian motion of solids in suspension.** Ladd, A.J.C.;Colvin, M.E.;Frenkel, D. (Lawrence Livermore National Laboratory, Livermore, California 94550). *Physical Review Letters;* **60**: No. 11, 975-978(14 Mar 1988). Contract W-7405-ENG-48.

An adaptation of lattice-gas cellular automata to the simulation of solid-fluid suspensions is described. The method incorporates both dissipative hydrodynamic forces and thermal fluctuations. At low solid densities, theoretical results for the drag force on a single disk and the viscosity of a suspension of disks are reproduced. The zero--shear-rate viscosity has been obtained over a range of packing fractions and results indicate that simulations of three-dimensional suspensions are feasible.

29624 **Validation study of vortex methods.** Sethian, J.A.;Ghoniem, A.F. (Department of Mathematics, University of California, Berkeley, California 94720). *Journal of Computational Physics;* **74**: No. 2, 283-317(Feb 1988).

Convergence of the vortex method applied to viscous, incompressible flow is demonstrated. We compute the solution of flow over a backwards-facing step for Reynolds number 50, 125, 250, 375, 500, and 5000, and study the effect of the choice of nu-

merical parameters on the accuracy of the computed solution. Within the laminar regime, we demonstrate convergence of the computed means to a time-independent solution as the numerical parameters are refined, decay of variance around the computed mean inversely proportional to the number of vortex elements, and accurate comparison of size and length of recirculation zones with experimental measurements as a function of Reynolds number. At higher Reynolds number, we show detailed and robust calculations of eddy shedding and pairing, and qualitative numerical convergence in such flow variables as eddy size and average velocity profiles. copyright 1988 Academic Press, Inc.

29625 **Estimating limits on resolution and predictability in computations of hydrodynamically unstable flows.** Viecelli, J.A. (Lawrence Livermore National Laboratory, Livermore, California 94550). *Journal of Computational Physics;* **74**: No. 2, 456-476(Feb 1988). Contract W-7405-ENG-48.

Unstable hydrodynamic flows containing different materials such as Rayleigh--Taylor instability rapidly evolve to a chaotic state with limited predictability and a distribution of materials having a fractral dimension. Here it is shown how Lagrange points, either existing as part of the hydrodynamic solution method or added as passive tracers, can be used to test for self-similarity and to compute the dimension and spatial resolution scaling for the Rayleigh--Taylor instability mixing region. The efficiency of the integral or point counting methods of estimating dimension is discussed and it is shown how it can be increased by order of magnitude factors using random sampling. The problem of how to compute the rate of loss of memory of initial conditions in the transient case is discussed and a quantity similar to a largest Lyapunov exponent is defined and used to determine the predictability time for the Rayleigy--Taylor problem. copyright 1988 Academic Press, Inc.

6451 Particle Interactions And Properties - Experimental

REFER ALSO TO CITATION(S) 29384, 29393, 29651

29626 **(CBPF-NF—034/87) Hadrons produced in atmospheric interactions.** Navia Ojeda, C.E.; Maldonado, R.H.C.; Portella, H.M.; Pinto, F.A.; Pinto, F.A.; Pinto, H.V. (Universidade Federal Fluminense, Niteroi (Brazil). Inst. de Fisica). (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702492/JAW.

Systematic analysis is made on cosmic ray induced atmospheric interactions detected to study the hadron multiple production. It is demonstrated that hadrons rich events are not characterized only by super families (halo events). About 5% of the events with visible energy in the range of 100-1000 TeV and transverse momentum sensity over the rapidity scale ≧1 GeV.km, has an anomalously 'hadron excess', already observed in super families (visible energy > 1000 TeV). The analysis did not include events identified as exotic ones (Centauro, Mini Centauro, Geminion and Chiron).

29627 **(CERN-EP—86-159) Status of W and Z physics in the UA1 and UA2 experiments.** Locci, E. (European Organization for Nuclear Research, Geneva (Switzerland); CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). 10 Oct 1986. 24p. (CONF-860977—5).

From Antiproton '86: European symposium on nucleon-antinucleon interactions; Thessalonika, Greece (1 Sep 1986).

The production and decay properties of the Intermediate Vector Bosons produced at the CERN p anti p Collider are presented. The longitudinal and transverse momentum distributions, and the jet activity associated with the W and Z events are well described by the QCD-improved Drell-Yan mechanism of quark-antiquark annihilation. There is no evidence for deviations from the expectations of the Standard Model. 20 refs., 16 figs., 8 tabs.

29628 **(CERN-EP—86-200) Antiproton-nucleon and antiproton-nucleus bound states.** Tauscher, L. (European Organization for Nuclear Research, Geneva (Switzerland)). 26 Nov 1986. 11p. (CONF-860977—7).

From Antiproton '86: European symposium on nucleon-antinucleon interactions; Thessalonika, Greece (1 Sep 1986).

This paper discusses the existence of bound states between antiprotons and nucleons. Described in this paper are the experimental methods and experimental evidence of these states. Also discussed are experiments with no evidence for narrow states. 32 refs., 8 figs., 1 tab. (LSP)

29629 **(CERN-EP—87-29) Future physics at hadron colliders.** Jenni, P. (European Organization for Nuclear Research, Geneva (Switzerland)). 13 Feb 1987. 20p. (CONF-8609223—9).

From ECFA workshop: LEP 200; Aachen, F.R. Germany (29 Sep 1986).

The physics potential of present and future hadron colliders is discussed in order to establish a basis for comparisons with the physics expected from LEP at its full energy (e^+e^- at $\sqrt{s}$ = 200 GeV). 44 refs., 15 figs.

29630 **(DOE/ER/10663—T3) Experimental elementary particle physics:.** Arenton, M.W.;Lai, K.W. (Arizona Univ., Tucson (USA)). Mar 1988. Contract AC02-80ER10663. 6p.

The activities of the experimental elementary particle physics group at the University of Arizona are described. These encompass a series of experiments at Fermilab on the subjects of hadronic production of heavy flavor states and on high transverse momentum phenomena.

29631 **Comparison of exclusive reactions at large t.** Baller, B.R.;Blazey, G.C.;Courant, H.;Heller, K.J.;Heppelmann, S.;Marshak, M.L.;Peterson, E.A.;Shupe, M.A.;Wahl, D.S.;Barton, D.S. (University of Minnesota, Minneapolis, Minnesota 55455). *Physical Review Letters;* **60**: No. 12, 1118-1121(21 Mar 1988).

Cross sections or upper limits are reported for 12 meson-baryon and two baryon-baryon reactions for an incident momentum of 9.9 GeVc, near 90° c.m.: π/sup +- /p→pπ/sup +- /,pp/sup +- /,π^+°/sup +- /,K^+ {Sigma}/sup +- /, (Λ^0 {Sigma}°)K^0,K/sup +- /p→pK/sup +- /;p/sup +- /p→pp. By studying the flavor dependence of the different reactions, we have been able to isolate the quark-interchange mechanism as dominant over gluon exchange and quark-antiquark annihilation.

29632 **Azimuthal energy flow in deep-inelastic neutrino scattering.** Mukherjee, A.;Bofill, J.;Busza, W.;Eldridge, T.;Friedman, J.I.;Fuess, S.;Goodman, M.C.;Kendall, H.W.;Lyons, T.;Magahiz, R. (Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physical Review Letters;* **60**: No. 11, 991-994(14 Mar 1988).

The azimuthal dependence of the flow of hadronic energy about the momentum-transfer direction in charged-current deep-inelastic neutrino-nucleon scattering is used to study gluon emission and the transverse momentum <k/sub T/> of partons confined inside the nucleon. A 7-standard-deviation azimuthal asymmetry is observed indicating an average <k/sub T/> = 0.303 +- 0.041 GeVc.

29633 **Pulsed-beam neutron-lifetime measurement.** Last, J.;Arnold, M.;Doehner, J.;Dubbers, D.;Freedman, S.J. (Physikalisches Institut der Universitaet Heidelberg, D-6900 Heidelberg, Federal Republic of Germany). *Physical Review Letters;* **60**: No. 11, 995-998(14 Mar 1988).

We have measured the neutron lifetime using a superconducting electron spectrometer and a pulsed beam of cold neutrons. Spatially defined neutron bunches are completely contained within the spectrometer's active volume while the β decay rate is measured. The flux is determined from the radioactivity of nearly totally absorbing thick samples of cobalt and gold exposed to the neutron beam. We obtain tau/sub n/ = 876 +- 21 sec.

29634 Evidence against broad dibaryons. Shypit, R.L.;Bugg, D.V.;Lee, D.M.;McNaughton, M.W.;Silbar, R.R.;Stewart, N.M.;Clough, A.S.;Hollas, C.L.;McNaughton, K.H.;Riley, P. (Queen Mary College, London E1{vert←bar}4NS, United Kingdom). *Physical Review Letters;* 60: No. 10, 901-904(7 Mar 1988).

Spin-correlation parameters A/sub L//sub L/, A/sub S// sub L/, A/sub N//sub L/, A/sub N/$_0$, A/sub S/$_0$, A/sub L/$_0$, and A$_0$/sub L/ have been measured for the reaction $pp \rightarrow np\pi^+$ at 492, 576, 643, 729, and 796 MeV. An isobar analysis determines magnitudes and phases of partial waves up to NN $^3F_3$. For the amplitude $NN(^1D_2) \rightarrow N\Delta(^5S_2)$, the phase shows a strong threshold enhancement in the NΔ channel, dropping from 44.4° +- 4.4° at 492 MeV to 11.9° +- 1.9° at 796 MeV. Other phases show little activity. Broad dibaryons are conclusively ruled out in $^1D_2$, $^3F_3$, and $^3P_2$ in this energy range.

29635 Study of the axial-vector form factor and second-class currents in antineutriono quasielastic scattering. Ahrens, L.A.; Aronson, S.H.; Gibbard, B.G.; Murtagh, M.J.; White, D.H.; Callas, J.L.; Cutts, D.; Diwan, M.; Hoftun, J.S.; Lanou, R.E. (Brookhaven National Lab., Upton, NY (USA). Physics Dept.; Brown Univ., Providence, RI (USA). Dept. of Physics). *Physics Letters* [*Section*] *B;* 202: No. 2, 284-288(3 Mar 1988).

The antineutrino quasielastic reaction anti ν/sub μ/p -> μ^+n has been studied in the Q^2 range up to 1.0 $(GeVc)^2$ at the Brookhaven AGS. The value of the axial vector mass M/sub A/ in the dipole parametrization of the form factor was determined from the shape of the Q^2 distribution to be 1.09+-0.03+-0.02 $GeVc^2$. A search for second-class currents was also conducted. No significant effect was found.

6452 Particle Interactions And Properties - Theoretical

REFER ALSO TO CITATION(S) 29578, 29587

29636 (CBPF-NF—037/87) On the nucleonics component of cosmic radiation, in the atmosphere. Oliveira Castro, F.M. de. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. 15p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702493/JAW.

The Shibata's solution of the diffusion equation as a complex integral is deduced. Its expression in the real domain is given by two different methods and a theorem of reciprocity is proved.

29637 (CBPF-NF—039/87) Weak interactions physics: from its birth to the eletroweak model. Lopes, J.L. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. 65p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88702494/JAW.

A review of the evolution of weak interaction physics from its beginning (Fermi-Majorana-Perrin) to the eletroweak model (Glashow-Weinberg-Salam). Contributions from Brazilian physicists are specially mentioned as well as the first prediction of electroweak-unification, of the neutral intermediate vector Z_0 and the first approximate value of the mass of the W-bosons.

29638 (CERN-EP—87-70) Electroweak radiative corrections at LEP energies. Barroso, A.;Beenakker, W.;Berends, F.A.;Blum, W.;Boudjema, F.;Burgers, G.J.H.;Burkhardt, H.;Caffo, M.;Cole, J.P.;Dombey, N.;Dydak, F.;Fleischer, J.;Gonzales, E.;Hollik, W.;Jadach, S.;Jegerlehner, F.;Kleiss, R.;Lanceri, L.;Lynn, B.W.;Mana, C.;Martinez, M.;Neugebauer, E.;Perret-Gallix, D.;Ragazzon, R.;Ratoff, P.;Romao, J.C.;Salicio, J.;Shapira, A.;Simopoulou, E.;Stuart, R.G.;van Neerven, W.L.;Verzegnassi, C.;Wachsmuth, H.;Was, Z. (Lisbon Univ. (Portugal); Rijksuniversiteit Leiden (Netherlands). Inst. Lorentz voor Theoretische Natuurkunde; Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (Germany, F.R.); Sussex Univ., Brighton (UK). Physics Div.; European Organization for Nuclear Research, Geneva (Switzerland); Siegen Univ. (Gesamthochschule) (Germany, F.R.). Fachbereich Physik). 9 Apr 1987. 46p. (CONF-8609223—6).

From ECFA workshop: LEP 200; Aachen, F.R. Germany (29 Sep 1986).

In the frame of the LEP 200 Workshop, a study group was set up to look into the problem of electroweak radiative corrections. Since these corrections were dealt with at the earlier LEP Workshop only as a side issue, and since their relevance extends to the entire energy range of LEP, the study group decided to have a global view of the matter, not confined to the high-energy regime alone. The study group set itself three tasks: first, to review and discuss the physics reward of electroweak radiative corrections;second, to attempt to unify the language and concepts in the calculation of electroweak radiative corrections;third, to make progress in the practical applications of electroweak radiative corrections - in their availability, in their technical implementation in the analysis of e^+e^- data, and in the way that data should be presented. This report summarizes the work of the study group. It also aims at familiarizing the non-expert reader with the field. Several contributions to the subject, which are of a more technical nature, are appended as annexes. 44 refs., 4 figs., 4 tabs.

29639 (GSI—88-16(prepr.)) Flavour kinetics in an expanding quark-gluon plasma. Barz, H.W.; Friman, B.L.; Knoll, J.; Schulz, H. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Mar 1988. 39p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753379/JAW.

A phenomenological model for the expansion of a quark-gluon plasma is presented and applied to ultra-relativistic nucleus-nucleus collisions. The flavour kinetics is described by rate equations allowing the abundances of the different constituents of the system to be out of equilibrium. The basic constituents are the quarks and gluons in the plasma phase and hadrons in the hadronic phase. Besides ordinary kinetic processes within the two phases (inelastic collisions), we construct a model for the confinement mechanism which is based on the string phenomenology of hadronization. The latter aspect constitutes the novel and essential part of the paper. Abundances of the various hadrons have been calculated for a baryon poor and a baryon rich scenario. The results show that during the hadronization process, the original quark content is roughly doubled. The resulting hadron abundances are found to depend on the hadronization mechanism, while the subsequent hadronic reactions do not have a significant effect on the final hadronic abundances. We find a $K^-\pi^-$ ratio as much as a factor 6 larger than in panti p collisions.

29640 (IC—87/73) Confinement models for gluons. Khadkikar, S.B.; Vinodkumar, P.C. (International Centre for Theoretical Physics, Trieste (Italy); Physical Research Lab., Ahmedabad (India)). (International Centre for Theoretical Physics, Trieste (Italy)). Apr 1987. 31p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702508/JAW.

Confinement model for gluons using a 'colour super current' is formulated. An attempt has been made to derive a suitable dielectric function corresponding to the current confinement model. A simple inhomogeneous dielectric confinement model for gluons is studied for comparison. The model Hamiltonians are second quantized and the glueball states are constructed. The spurious motion of the centre of confinement is accounted for. The results of the current confinement scheme are found to be in good agreement with the experimental candidates for glueballs. (author). 16 refs, 3 tabs.

29641 (IC—87/83) Universal law for the increase of hadronic cross sections at high energies. Barut, A.O.; Boukraa, S. (International Centre for Theoretical Physics, Trieste (Italy)). Apr 1987. 16p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702518/JAW.

We show that all known total cross-sections can be well described by a simple universal formula σ/sub tot/ = σ/sub O/ +

(A)s¹2 + .388ln²(s)44.44(mb), s in (GeV)². The constant σ/sub O/ is the same for the reactions ab and a-barb. A number of further predictions are given and a dynamical model for the high energy logarithmic increase is suggested. The second term is due to exchange processes. (author). 19 refs, 3 figs, 2 tabs.

29642 **(IC—87/184) CP-violation and mixing in a superstring inspired model.** Raychaudhuri, A. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1987. 5p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702553/JAW.

Superstring theories lead to supersymmetric E_6 based models which contain exotic charge -13 quarks, h. We find that if the h mixes with the b quark then CP-violation and mixing are dramatically affected. (author). 9 refs.

29643 **(IFT-P—25/87) Features of Chiral-Symmetry breaking from two alternative effective potentials.** Montero, J.C.; Pleitez, V. (Instituto de Fisica Teorica, Sao Paulo (Brazil)). 1987. 24p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702562/JAW.

Some features of two alternative effective potentials in QCD is discussed. Calculations with both effective potentials show that they have opposite chiral phase transition direction.

29644 **(INIS-BR—973) Pure Gauge theory in crystal lattice and Coulomb gases.** Marchetti, D.H.U. (Sao Paulo Univ. (Brazil). Inst. de Fisica). 1985. 83p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702568/JAW.

A method for the construction of classical gases, starting from a pure gauge theory, is described. The method is applied to the U(1) gauge theory in two spatial dimensions. For this model it's seen the vaccua appearing as a consequence of the quantization ambiguity. The connection between the vaccua and the confinement is discussed.

29645 **(INIS-BR—975) PIN scattering at low energies.** Menezes, A.M.M. (Sao Paulo Univ. (Brazil). Inst. de Fisica). 1985. 153p. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88702570/JAW.

The pion-nucleon scattering for energies up to 300 MeV is studied by means of a theoretical model based on chiral symmetry, implemented by effective lagrangians. The interaction between the pion and the nucleon is mediated by only four particles: nucleon, delta, rho e sigma. The amplitudes associated to the delta and sigma contain free parameters, that must be extracted from experiment. The set of values obtained from fits below and above threshold disagree, indicating that, in the context of the model, a unified description in both regions is not possible. The results above threshold are sensitive to the method of unitarization employed. The method adopted in this work has a simple physical meaning and the ressonating wave associated to the delta is quite well reproduced.

29646 **(UWThPh—1987-38) Model of massive neutrinos with a conserved lepton number.** Grimus, W. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1987. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702620/JAW.

To be published in the Proc. of 'Hadron Structure 87', Smolenice (CS), Nov 1987.

We consider a left-right symmetric model with the standard assignments of fermion and scalar fields which possesses a strictly conserved lepton number. 6 refs.

29647 **(UWThPh—1987-39) Spontaneous CP violation and neutral flavour conservation in SU(2)/sub L/xU(1).** Neufeld, H. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1987. 5p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702621/JAW.

To be published in the Proc. of 'Hadron Structure 87', Smolenice (CS), Nov 1987.

In the standard model with a single Higgs doublet, CP violation occurs through the Kobayashi-Maskawa mechanism for at least three quark generations (n/sub G/≧3). An attractive alternative is provided by the concept of spontaneous CP violation. One has to find the general conditions that a given Lagrangian is CP invariant before symmetry breaking. Here a model is discussed based on the gauge group SU(2)/sub L/xU(1) with an arbitrary number n/sub H/ of Higgs doublets. 12 refs. (qui).

29648 **(UWThPh—1987-40) Influence of strong interactions on electromagnetic mass differences.** Schoeberl, F. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1987. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702622/JAW.

Calculating the electromagnetic mass differences of mesons in the framework of a non-relativistic potential model we find in contrast to experiment that B^0-B^+ <0. The reason is that the influence of the m/sub d/-m/sub u/ mass difference to the strong interaction can be larger than the electromagnetic effect. In other words, the qq-bar-bound state containing the lighter quark may be heavier than the qq-bar bound state containing the heavier quark. A general condition for this problem is given. 17 refs., 1 tab.

29649 **(UWThPh—1987-42) Non-leptonic weak interactions in Chiral perturbation theory.** Ecker, G. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1987. 15p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702623/JAW.

To be published in the Proc. of 'Hadron Structure 87', Smolenice (CS), Nov 1987.

Prospects for testing QCD in non-leptonic weak decays are analyzed in the framework of the effective chiral Lagrangian of the Standard Model. 23 refs., 5 figs.

29650 **Duality and multi-gluon scattering.** Mangano, M.; Parke, S.; Xu Zhan. (Fermi National Accelerator Lab., Batavia, IL (USA)). *Nuclear Physics [Section] B;* **298**: No. 4, 653-672(21 Mar 1988).

For the six-gluon scattering process we give explicit and simple expressions for the amplitude and its square. To achieve this we use an analogy with string theories to identify a unique procedure for writing the multi-gluon scattering amplitudes in terms of a sum of gauge invariant dual sub-amplitudes multiplied by an appropriate color (Chan-Paton) factor. The sub-amplitudes defined in this way are invariant under cyclic permutations, satisfy powerful identities which relate different non-cyclic permutations and factorize in the soft gluon limit, the two-gluon collinear limit and on multi-gluon poles. Also, to leading order in the number of colors these sub-amplitudes sum incoherently in the square of the full matrix element. The results contained here are important for Monte Carlo studies of multi-jet processes at hadron colliders as well as for understanding the general structure of QCD.

29651 **Measuring the shape of an excited hadron by use of the Bose-Einstein effect.** Osborne, L.S. (Physics Department and Laboratory for Nuclear Science, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physical Review Letters;* **60**: No. 11, 987-990(14 Mar 1988).

A method is proposed to analyze the Bose-Einstein effect in lepton-hadron and e^+-e^- collisions in such a way as to measure longitudinal source extensions. A model is used which predicts measurable longitudinal source extensions as a function of excitation energy and meson-pair energy.

29652 **Separable approximation method for two-body relativistic scattering.** Tandy, P.C.;Thaler, R.M. (Department of Physics, Kent State University, Kent, Ohio 44242). *Physical Review [Section] C: Nuclear Physics;* **37**: No. 3, 1142-1147(Mar 1988).

A method for defining a separable approximation to a given interaction within a two-body relativistic equation, such as the Bethe-Salpeter equation, is presented. The rank-N separable representation given here permits exact reproduction of the T matrix on the mass shell and half off the mass shell at N selected bound state and/or continuum values of the invariant mass. The method employed is a four-space generalization of the separable representation developed for Schroedinger interactions by Ernst, Shakin, and Thaler, supplemented by procedures for dealing with the relativistic spin structure in the case of Dirac particles.

29653 **On the finite-temperature transition of QCD.** Gupta, R.; Guralnik, G.; Kilcup, G.W.; Patel, A.; Sharpe, S.R. (Los Alamos National Lab. (LANL), NM (USA). Theoretical Div.; Brown Univ., Providence, RI (USA). Dept. of Physics; European Organization for Nuclear Research, Geneva (Switzerland). Theory Div.; Stanford Linear Accelerator Center, CA (USA)). *Physics Letters [Section] B;* **201**: No. 4, 503-509(18 Feb 1988).

Using an exact algorithm to incorporate dynamical quarks, we present evidence from numerical simulations that the finite-temperature transition in QCD is first order for realistic quark masses. For two light flavors of quarks we see a two state signal, with flip-flops between these states. For four flavors we show that the first-order transition extends to quark masses heavier than T/sub c/.

29654 **Ultraviolet divergences and supersymmetric theories.** Sagnotti, A. (California Univ., Berkeley (USA). Dept. of Physics;Lawrence Berkeley Lab., CA (USA)). pp v of Elementary particles. Proceedings. Cabibbo, N. (ed.). Amsterdam, Netherlands; North-Holland (1987). (CONF-8406212—). Contract AC03-76SF00098.

From International school of physics "Enrico Fermi"; Varenna, Italy (18 Jun 1984).

I attempt to outline the present understanding of the ultraviolet behavior of supersymmetric theories. Two things emerge clearly from this discussion. We have at our disposal a class of completely finite renormalizable models with extended global supersymmetry, and we have a number of formal ways of proving their finiteness. However, at present the motivation for looking at such theories is not clear. More precisely, it is not clear why a finite model should be preferred to other infinite, but still renormalizable and predictive, ones. On the other hand, supergravity theories are a priori far more interesting, as they offer a perspective for unifying all interactions including gravity. However, their couplings are parametrized by Newton's constant, which is of negative mass dimension. Thus these theories are all potentially nonrenormalizable. At present it does not seem possible to prove that they are finite along the lines of what has been achieved for supersymmetric Yang-Mills theories. All the available arguments fail, in one way or another, due to the presence of a dimensional coupling. Moreover, the indications of the indirect analysis are rather discouraging, and suggest that divergences should really set in at the 'obvious' number of loops, three. Of course, explicit calculations in (super)gravity theories would be most illuminating. Hopefully, the integration technique mentioned in section 3, together with the development of a suitable computer software and, at least, the completion of the work, should make this nontrivial task accessible in the near future.

29655 **Skyrmions in nuclear physics.** Meissner, U.;Zahed, I. (Institute of Theoretical Physics, University of Regensburg, D-8400 Regensburg, Federal Republic of Germany). *Advances in Nuclear Physics;* **17**: No. 1, 143-222(1986).

A review of the essential features of the SU(2) Skyrme model which are relevant to nuclear physics is given. t'Hooft's and Witten's low-energy, large color limit of QCD as an effective Lagrangian for describing weakly interacting mesons and the baryonchiral soliton equivalence is given and explicated. Static baryon properties are explained in terms of a spherical hedgehog configuration via a suitable spin-isospin projection. The physical properties of the baryon mass spectra are discussed. Numerical results of calculations for the NN interaction described in terms of an underlying skyrmion-skyrmion interaction are given. (AIP)

6453 Particle Invariance Principles And Symmetries

REFER ALSO TO CITATION(S) 29642, 29660

29656 **(CBPF-NF—043/87) Anticommuting space: an alternative formulation of the wavefunction antisymmetry description.** Mundim, K.C. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. 22p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702496/JAW.

A Multilinear Alternating Space is introduced as a N-linear map of the Hilbert Space, so that its properties can be used to obtain the antisymmetry of the wave function and the Pauli principle. An alternative interpretation to the description of creation and annihilation operators is also discussed. (G.D.F.).

29657 **(SI—86-18) One-loop N=2 supercurrent anomaly.** Marculescu, S. (Siegen Univ. (Gesamthochschule) (Germany, F.R.). Fachbereich 7 - Physik). 1986. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753393/JAW.

A one-loop superspace calculation of the N=2 supercurrent anomaly is performed. The method preserves explicitiy both N=2 supersymmetry and gauge invariance.

6454 Field Theory

REFER ALSO TO CITATION(S) 29720

29658 **(CBPF-NF—040/87) Generalized Yang-Mills Theory I: general aspects of the classical theory.** Galvao, C.A.P. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. 23p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702495/JAW.

A generalized Yang-Mills theory which is the non-Abelian version of the generalized eletrodinamics proposed by Podolsky is analysed both in the Lagrangian an Hamiltonian formulation. A simple class of solutions to the Euler-Lagrange equations is presented and the structure of the Hamiltonian constraints is studied in details.

29659 **(CBPF-NF—048/87) BRST invariant closed three Reggeon (String) vertex.** Rego Monteiro, M.A. do. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702498/JAW.

A BRST invariant three Reggeon vertex for a closed bosonic string is constructed. The result is a simple functional of matter and ghost fields.

29660 **(IC—87/74) Semiclassical quantization of the supermembrane.** Duff, M.J.; Inami, T.; Pope, C.N.; Sezgin, E.; Stelle, K.S. (International Centre for Theoretical Physics, Trieste (Italy)). May 1987. 23p. (CERN-TH—4731/87). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702509/JAW.

We approach the quantization of the eleven-dimensional supermembrane from a semiclassical viewpoint. We quantize the fluctuations around a topologically-stabilized toroidal background, and find that the bosonic and fermionic contributions to the vacuum energy cancel. This result appears to depend crucially on the fermionic gauge symmetry and spacetime supersymmetry. (author). 23 refs.

29661 **(IC—87/75) Multi-instanton solutions in the harmonic approach to self-dual Yang-Mills equations.** Kalitzin, S.; Sokatchev, E. (International Centre for Theoretical Physics, Trieste (Italy)). Apr 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702510/JAW.

The unconstrained harmonic potential giving rise to the general 8q-3 parameter q-instanton solution of the SU(2) Yang-Mills equations is found. The original problem of solving the non-linear equations of self-duality is reduced to a linear differential equation on S^2. The explicit solution is obtained in the case of a 't Hooft type Ansatz. (author). 9 refs.

29662 **(IC—87/89) Non-linear sigma models on arbitrary genus Riemann surfaces.** Aldazabal, G.; Diaz, A.H.; Zhang, R.B. (International Centre for Theoretical Physics, Trieste (Italy)). May 1987. 17p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702524/JAW.

A Ward-Takahashi type identity is obtained for two insertions of the energy-momentum tensor of the non-linear sigma model on an arbitrary Riemann surface. The identity shows explicitly how the Virasoro algebra is violated by spurious terms generated by the

trace anomaly. Requiring these terms to vanish leads to a set of constraints on the graviton and dilaton background fields, which are necessary for the algebra to be restored. Although the modular parameters play an important role in the computation, the background field equations turn out to be genus independent up to order α'. (author). 10 refs, 2 figs.

29663 (IC—87/107) Hamiltonian formulation of the supermembrane. Bergshoeff, E.; Sezgin, E.; Tanii, Y. (International Centre for Theoretical Physics, Trieste (Italy)). Jun 1987. 18p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702542/JAW.

The Hamiltonian formulation of the supermembrane theory in eleven dimensions is given. The covariant split of the first and second class constraints is exhibited, and their Dirac brackets are computed. Gauge conditions are imposed in such a way that the reparametrizations of the membrane with divergence free 2-vectors are unfixed. (author). 10 refs.

29664 (LA-UR—88-629) Introduction to lattice gauge theory. Gupta, R. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 47p. (CONF-8707141—5).

From Theoretical advanced summer institute; Santa Fe, NM, USA (6 Jul 1987).

The lattice formulation of Quantum Field Theory (QFT) can be exploited in many ways. We can derive the lattice Feynman rules and carry out weak coupling perturbation expansions. The lattice then serves as a manifestly gauge invariant regularization scheme, albeit one that is more complicated than standard continuum schemes. Strong coupling expansions: these give us useful qualitative information, but unfortunately no hard numbers. The lattice theory is amenable to numerical simulations by which one calculates the long distance properties of a strongly interacting theory from first principles. The observables are measured as a function of the bare coupling g and a gauge invariant cut-off $\simeq 1/a$, where a is the lattice spacing. The continuum (physical) behavior is recovered in the limit $a \rightarrow 0$, at which point the lattice artifacts go to zero. This is the more powerful use of lattice formulation, so in these lectures the author focuses on setting up the theory for the purpose of numerical simulations to get hard numbers. The numerical techniques used in Lattice Gauge Theories have their roots in statistical mechanics, so it is important to develop an intuition for the interconnection between quantum mechanics and statistical mechanics. This will be the emphasis of the first lecture. In the second lecture, the author reviews the essential ingredients of formulating QCD on the lattice and discusses scaling and the continuum limit. In the last lecture the author summarizes the status of some of the main results. He also mentions the bottlenecks and possible directions for research. 88 refs.

29665 (UWThPh—1987-37) Solitons in supergravity. Embacher, F. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1987. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702619/JAW.

Talk given at the Second Hungarian Relativity Workshop, Sep 1987.

The interaction of N=2 supergravity solitons is worked out in the non-relativistic limit, and an effective quantum field theory of solitons is formulated. 12 refs.

29666 (UWThPh—1987-45) Free bosonic string field theory without supplementary fields. Embacher, F. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1987. 39p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702624/JAW.

A covariant local action for free bosonic string fields is constructed without the use of supplementary fields. The open string case is treated in detail. Up to a mathematical conjecture which is likely to hold it is shown that the Virasoro constraints arise as a special choice of gauge. The kinetic operator turns out to be extremely simple, the gauge transformation law arising rather implicitly. The case of closed strings is briefly discussed. 25 refs.

29667 Line functional theory for strings. I. Carson, L.; Hosotani, Y. (School of Physics and Astronomy, University of Minnesota, Minneapolis, Minnesota 55455). *Physical Review [Section] D: Particles and Fields;* 37: No. 6, 1492-1518(15 Mar 1988).

String field theory is defined as a theory of line functionals (functions of geometric lines) which reproduces classical Nambu-Goto string dynamics in a certain limit. Various properties of geometric line space are reviewed, and the unique measure on the space of lines is also given. The connection of the string field equation to Nambu-Goto string dynamics is made in the x_0 = tau gauge, which necessitates the introduction of multicomponent line functionals and new generalizations of the Dirac algebra. As a consequence the string fields transform nontrivially under Lorentz transformations and describe either bosons or fermions depending on the parameters of the equation. The equation is solved in three dimensions, which yields typical string excitations with an equally spaced mass-squared spectrum and linearly rising trajectories. We find no tachyon. Moreover, ground states are always massless, irrespective of the values of the five parameters defining the equation.

65 PHYSICS II

6510 Nuclear Physics

REFER ALSO TO CITATION(S) 29628, 29693

6511 Experimental Techniques

29668 (CONF-8711116—7) Comparisons of VUU [Vlasov-Uehling-Uhlenbeck] predictions with streamer chamber data. Keane, D.;Chu, S.Y.;Fung, S.Y.;Liu, Y.M.;Qiao, L.J.;VanDalen, G.;Vient, M.;Wang, S.;Molitoris, J.J.;Stoecker, H. (California Univ., Riverside (USA). Dept. of Physics; Frankfurt Univ. (Germany, F.R.). Inst. fuer Theoretische Physik). 1987. Contract FG03-86ER40271. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005289/JAW.

From 8. high energy heavy ion study; Berkeley, CA, USA (16 Nov 1987).

Experimental charged particle inclusive and exclusive parameters for several nuclear systems are compared with microscopic model predictions based on the Vlasov-Uehling-Uhlenbeck equation, for various density-dependent nuclear equations of state (EOS). Inclusive variables and multiplicity distributions are in good agreement, and are not sensitive to the EOS. Rapidity spectra show evidence of being useful in determining whether the model uses the correct sections for binary collisions in the nuclear medium, and whether momentum dependent interactions are correctly incorporated. Sideward flow parameters do not favor the same nuclear incompressibility at all multiplicities, and there are indications that the present model may provide only an upper limit on the true stiffness of the EOS. Findings relating to impact parameter averaging and the mass and energy dependence of transverse flow are also presented. 24 refs., 6 figs., 1 tab.

29669 (LA-UR—88-421) Capabilities and plans for preequilibrium nuclear reaction measurements at target-4 at LAMPF [Los Alamos Meson Physics Facility]. Haight, R.C.; Ullmann, J.L.; Lisowski, P.W.; Wender, S.A.; Nelson, R.O.; Seestrom-Morris, S.; King, N.S.P.; Rapaport, J.; Zecker, P.; Brady, F.P. (Los Alamos National Lab., NM (USA); Ohio Univ., Athens (USA). Dept. of Physics; California Univ., Davis (USA). Dept. of Physics; Duke Univ., Durham, NC (USA). Dept. of Physics). Feb 1988. Contract W-7405-ENG-36. 7p. (CONF-880232—3). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88006470/JAW.

From Nuclear Energy Agency Nuclear Data Committee (NEANDC) specialists' meeting on preequilibrium nuclear reactions; Semmerling, Austria (10 Feb 1988).

The Target-4 neutron source at the Los Alamos Meson Physics Facility (LAMPF) has recently been commissioned and used as a {open quotes}white{close quotes} source of fast neutrons

from 1 to 500 MeV. A 90-meter flight path at a neutron production angle of 15 degrees has been characterized for neutron flux and spectral shape. The flux and shape agree well with calculated values showing that this is indeed an intense and useful white neutron source. Initial measurements of the /sup 12/C(n,p) reaction at forward angles have been made in the energy range 50 to 500 MeV. The results point the way to improve detector schemes and to a program of (n,p) cross section measurements in the energy range where preequilibrium processes dominate much of the charged-particle emission spectra. 3 refs., 2 figs.

6512 Nuclear Properties And Reactions, A=1-5, Experimental

29670 **(DOE/ER/40362—1) Pion- and proton-nucleus interactions at intermediate energy:.** Dehnhard, D. (Minnesota Univ., Minneapolis (USA)). Jan 1988. Contract FG02-87ER40362. 36p.

A major effort was made in the study of proton and pion induced reactions on ^{4}He. Spin transfer observables were measured for the first time for the ^{4}He({rvec p},{rvec p}') reaction at 500 MeV at the Los Alamos Meson Physics Facility. The preliminary results show a spin-flip probability in the continuum of ^{4}He which is much larger than the free proton-proton scattering value. The group also collaborated in the related ^{4}He({rvec p},p'X) work done at the Indiana University Cyclotron Facility. The work on data reduction of the ^{4}He(π^+,π^+'p) and ^{4}He {plus} π{+-} elastic scattering experiments was continued and new data were taken for ^{13}C(π^+,π^+ p). A new analysis of 2^+ states in ^{14}C excited by π/sup {plus/}, π/sup {minus/}, and proton scattering was performed using large-space shell model calculations.

6513 Nuclear Properties And Reactions, A=6-19, Experimental

29671 **(LBL—24737) Systematics of complex fragment emission in niobium induced reactions.** Wozniak, G.J.;Charity, R.J.;Moretto, L.G. (Lawrence Berkeley Lab., CA (USA)). Jan 1988. Contract AC03-76SF00098;AC02-76ER04052. 14p. (CONF-871243—7). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88007387/JAW.

From Symposium on hot nuclei; College Station, TX, USA (7 Dec 1987).

Complex fragments of 3 < Z {approx<—gt} 35 have been detected in the reverse-kinematics reactions of ^{93}Nb plus ^{9}Be, ^{12}C and ^{27}Al at bombarding energies of EA = 11.4, 14.7 and 18.0 MeV. Velocity spectra and angular distributions show the presence of projectile and target-liek components along with a component isotropic in the reaction plane. This latter component appears as a Coulomb ring in the invariant cross section plots indicating the presence of a binary decay which is confirmed by the coincidence data. 6 refs., 6 figs.

29672 **Determination of single-nucleon wave functions by transverse electron scattering.** Hicks, R.S.;Button-Shafer, J.;Debebe, B.;Dubach, J.;Hotta, A.;Huffman, R.L.;Lindgren, R.A.;Peterson, G.A.;Singhal, R.P.;de Jager, C.W. (Department of Physics and Astronomy, University of Massachusetts, Amherst, Massachusetts 01003). *Physical Review Letters;* 60: No. 10, 905-908(7 Mar 1988).

Transverse form factors have been measured for elastic electron scattering from /sup 10/B and /sup 11/B, as well as for the electroexcitation of the 1.74-MeV (J/sup π/ = O/sup +/, T = 1) and 5.17-MeV (2/sup +/, 1) levels of /sup 10/B. These results were utilized to determine the radial shape of the 1p/sub 3/2/ single-particle wave function within the nuclear interior.

29673 **Isobaric-analog-state transitions in pion charge-exchange reactions above the Δ(1232) resonance.** Rokni, S.H.; Baer, H.W.; Bergmann, A.G.; Bowman, J.D.; Irom, F.; Leitch, M.J.; Seftor, C.J.; Alster, J.; Piasetzky, E.; Clausen, B.L. (Utah State Univ., Logan (USA); Los Alamos National Lab., NM (USA); Tel Aviv Univ. (Israel). Sackler Faculty of Exact Sciences). *Physics Letters [Section] B;* 202: No. 1, 35-39(25 Feb 1988).

Forward-angle differential cross sections for the (π^+,π^0) reaction to isobaric analog states were measured at 300, 425, 500, and 550 MeV on targets ranging in mass from ^{7}Li to ^{208}Pb. The extrapolated 0° cross sections are found to rise markedly between 300 and 425 MeV, contrary to the behavior of the free πN process. The mass and energy dependence of the cross sections at the higher energies are discussed within the framework of the Glauber model.

6514 Nuclear Properties And Reactions, A=20-38, Experimental

29674 **(CSIR-TWISK-TR—454) Centre of mass effects at finite temperature.** Quick, R.M.; Miller, H.G.; Vary, J.P. (Iowa State Univ. of Science and Technology, Ames (USA). Dept. of Physics). (Council for Scientific and Industrial Research, Pretoria (South Africa). National Research Inst. for Mathematical Sciences). [1987]. 12p. CSIR, Publications Distribution, P.O. Box 395, Pretoria, 0001, South Africa.

Finite temperature Hartree-Fock calculations in ^{24}Mg seem to indicate that the lowest lying prolate, oblate and spherical solutions exhibit unexpected structure in the internal energy at T ≅ .5 - 1.0 MeV. For these solutions the ensemble average of the centre-of-mass kinetic energy operator exhibits similar structure in the same temperature range, which leads us to believe that the centre of mass is not necessarily thermally quiescent.

29675 (DOE/ER/75172—5, pp 64-67) **Measured excitation functions for the ^{27}Al + d → ^{24}[15.02h] reaction.** Barnett, J.M. (Arizona State Univ., Tempe). 1987. NTIS, PC A06/MF A01. Order Number DE88005041/JAW. (CONF-8703231—Summs.).

From Western region American Nuclear Society student conference: nuclear technology for the year 2000; Albuquerque, NM, USA (19 Mar 1987).

The excitation function for the nuclear reaction in which ^{27}Al was bombarded with deuterium ions from an accelerator to form the radioactive isotope of ^{24}Na was evaluated. From the excitation function, which is a plot of the cross section versus the energy of the bombarding particle, it is possible to determine the threshold energy for a particular reaction process. Twenty-four sodium emits a well known γ-ray energy of 1368 keV. The intensity of this γ-ray can be measured, and is a measure of how many ^{24}Na atoms are present at the time the target foil is counted. Since the aluminum foils were counted for ^{24}Na at a time after irradiation, the initial number of ^{24}Na atoms had to be calculated from the experimental data. It was then possible to calculate the cross sections for the ^{24}Na because the cross section depends upon the initial number of atoms. The excitation function yielded an interesting shape. Considering the shape of the plot, it was determined that two reactions were energetically possible. The first was ^{27}Al (d, ap) ^{24}Na reaction starting at 3.2 MeV was possible. The conclusion was since neutrons were not used in the experiment, the titanium foils which were being irradiated at the same time as the aluminum foils were able to break up some of the deuterium ions and produce the neutrons. Therefore, it appears that both reactions were taking place simultaneously at the time of the experiment.

6519 Nuclear Properties And Reactions, A=190-219,

Experimental

29676 (CERN-EP—86-206) Measurement of the antiproton magnetic moment and a determination of the spin-orbit term for the antiproton-nucleus interaction. Kreissl, A.;Chardalas, M.;Dedoussis, S.;von Egidy, T.;Hancock, A.D.;Hartmann, F.J.;Kanert, W.;Koch, H.;Koehler, T.;Nilsson, A.;Plendl, H.;Poth, H.;Raich, U.;Reidy, J.J.;Rohmann, D.;Schmidt, G.;Suffert, M.;Tauscher, L.;Wolf, A. (Basel Univ. (Switzerland). Inst. fuer Physik; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik; Mississippi Univ., University (USA). Dept. of Physics and Astronomy; Technische Univ. Muenchen, Garching (Germany, F.R.). Fakultaet fuer Physik; Forskningsinstitutet foer Atomfysik, Stockholm (Sweden); Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). 11 Dec 1986. 8p. (CONF-860977—4).

From Antiproton '86: European symposium on nucleon-antinucleon interactions; Thessalonika, Greece (1 Sep 1986).

The measurement of the fine-structure splitting of antiprotonic x-ray transitions in heavy nuclei allows a detailed study of the particle properties and the anti p-nucleus interaction. From the splitting of the anti $p^{208}Pb$ 11 $\rightarrow$ 10 transition, the magnetic moment μ/sub anti p/ of the antiproton was determined to an accuracy of 3×10^{-3}. In anti $p^{174}Yb$, the splitting of the last observable transition 9 $\rightarrow$ 8 contains the information on a possible spin-orbit term of the anti p-nucleus interaction. The effect of this term can be investigated for the first time. 5 refs., 3 figs.

6520 Nuclear Properties And Reactions, A=220 And Above, Experimental

29677 Intrinsic reflection asymmetry in ^{225}Ra. Additional information from a study of the α-decay scheme of ^{229}Th. Helmer, R.G.;Lee, M.A.;Reich, C.W.;Ahmad, I. (Idaho National Engineering Lab., Idaho Falls (USA);Argonne National Lab., IL (USA)). *Nuclear Physics [Section] A;* **474**: No. 1, 77-113(16 Nov 1987). Contract AC07-76ID01570;W-31-109-ENG-38.

The level structure of ^{225}Ra has been studied by measuring the radiations associated with the α-decay of ^{229}Th. These measurements include α- and γ-singles spectra, and $\alpha\gamma$-, αe^--, and $\gamma\gamma$-coincidence measurements. The α-spectra were measured with a high-resolution magnetic spectrometer and Si surface-barrier detectors, the γ-ray spectra with Ge and Ge(Li) semiconductor detectors and the electron spectra with a Si(Li) detector. Chemically purified and isotope-separated sources were used for various experiments. These data provide the energies and intensities for 20 α-branches and for $\simeq$ 87 γ-rays. From this information and previous e^- spectrograph measurements, $\simeq$ 81 γ-rays are placed in a level scheme involving 22 excited states below 400 keV. Twenty of these excited states (excluding only tentative levels at 203 and 248 keV) can be assigned as members of four bands having K/sup π/ = 12^+ (ground state), 12^- (55.1 keV), 32^+ (149.9 keV) and 52^+ (236.7 keV). (orig.HSI).

6530 Nuclear Theory

REFER ALSO TO CITATION(S) 29655, 29655, 29668

29678 (CBPF-NF—019/87) Dynamical effects in the Colomb expansion following nuclear fragmentation. Chung, K.C.; Donangelo, R.J.; Schechter, H. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro; Rio de Janeiro Univ. (Brazil). Inst. de Fisica). (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. 16p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702490/JAW.

The effects of the Colomb expansion on the fragment Kinetic energy spectrum for a fragmentating hot nuclear system is investigated. In particular, ^{12}C fragment spectra are calculated and compared with those predicted by the uniform expansion approximation. The results indicate that energy spectra of fragments are quite sensitive to the details of the Coulomb expansion treatment.

29679 (DOE/ER/04215—T4) Nuclear structure studies at intermediate energies:. Hintz, N.M. (Minnesota Univ., Minneapolis (USA). School of Physics and Astronomy). 31 Dec 1987. Contract AC02-77ER04215. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006683/JAW.

This paper discusses progress on studies on nuclear structure at the University of Minnesota. Some of the topics discussed are: nucleon-nucleon interactions, high spin stretched states, deformed and transition nuclei, giant resonances, measurement of spin observables, pion scattering, delta resonances, and electron scattering. (LSP)

29680 (DOE/ER/40370—T1) Theory of photon and electron induced reactions:. Onley, D.S.; Wright, L.E. (Ohio Univ., Athens (USA). Dept. of Physics and Astronomy). Mar 1988. Contract FG02-87ER40370. 12p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88007144/JAW.

During the first eight months of our new grant from the Department of Energy we have made considerable progress or have completed our studies on the following aspects of the general investigation of electron and photon induced reactions: photo- and electro-production of mesons;the radiation tail accompanying elastic electron scattering and pair production;studies involving relativistic shell model;and electrofission conincidence angular distributions. We will report on each of these developments in this paper.

29681 (DOE/ER/40376—1) Microscopic heavy-ion theory:. Oberacker, V.E.; Umar, A.S. (Vanderbilt Univ., Nashville, TN (USA). Dept. of Physics and Astronomy). 1988. Contract FG05-87ER40376. 17p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88007561/JAW.

We report the research activities of the theoretical nuclear physics group at Vanderbilt University during the period August 1987 to January 1988. Research efforts continue in extension of time-dependent Hartree-Fock studies to include spin degrees of freedom and spin-orbit interactions and implications on low energy heavy-ion collisions;calculation of two-dimensional energy surfaces in the search of superheavy molecules and implications of the observed positron peaks in heavy-ion collisions;development of numerical methods for the calculation of continuum excitation amplitudes in ion-ion and ion-atom collisions with applications to prompt nucleon emission i heavy-ion collisions;theoretical investigations of extracting exclusive amplitudes from time-dependent Hartree-Fock calculations;calculation of the ground state properties of deformed nuclei in the relativistic mean-field representation;and other studies such as exotic radioactivity. Some of the above work involve collaborators from various institutions, including Oak Ridge National Laboratory, University of Frankfurt, GSI, and University of Pennsylvania. This report is composed of abstracts of papers and conference proceedings published or submitted for publication.

29682 (GSI—87-56(prepr.)) Expansion dynamics and multifragmentation of a saturating system of fermions. Knoll, J.; Wu Jianshi. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Sep 1987. 22p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753375/JAW.

A quantum dynamical model is proposed to describe the expansion phase of highly excited systems formed in energetic heavy ion collisions. As an application the evolution of a saturating system of Fermions and its disassembly into many fragments are studied in a two-space and one-time dimensional model world.

29683 (GSI—88-17(prepr.)) Evaporation of particles from hot nuclei. He Zejun; Wu Jianshi; Noerenberg, W. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Mar 1988. 16p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753380/JAW.

For particle evaporation from hot nuclei a model is proposed which is applicable to high excitation energies where the mean free path of nucleons becomes comparable to or smaller than the size of the nucleus. The formalism allows to calculate the time evolution of the emitting system and the evaporation rates and spectra of the emitted particles. The nucleus ^{133}Cs with an initial

temperature of 18 MeV is studied as an example. Implications for intermediate-energy heavy-ion collisions are indicated.

29684 **(IC—87/93) Relativistic motion of the Λ in hypernuclei and phenomenological analysis of its binding energy.** Koutroulos, C.G.; Grypeos, M.E. (Thessaloniki Univ. (Greece). Dept. of Theoretical Physics). (International Centre for Theoretical Physics, Trieste (Italy)). May 1987. 44p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702528/JAW.

A phenomenological analysis of the ground state binding energy B/sub Λ/ of a Λ-particle in hypernuclei, which is based on the Dirac equation with scalar potential and fourth component of vector potential of rectangular shapes and of the same radius, is presented. Analytic expressions are obtained for the corresponding small and large component radial wave functions and the eigenvalue equation for B/sub Λ/ is also given. The latter leads to approximate "semiempirical mass-formulae": B/sub Λ/ - B/sub Λ/(A), for "sufficiently large" values of the mass number of the core nucleus A. In addition, estimates are performed for B/sub Λ/ and also for the (average) effective mass of the Λ-particle and for the "depth" of the "Schroedinger-equivalent potential" by fitting the values of B/sub Λ/, (resulting either from the numerical solution of the eigenvalue equation or from approximate analytic expressions) to experimental data. (author). 35 refs, 9 tabs.

29685 **(IFT-P—23/87) Unified treatment of bound-state and scattering problems.** Adhikari, S.K.; Tomio, L. (Pernambuco Univ., Recife (Brazil). Dept. de Fisica). (Instituto de Fisica Teorica, Sao Paulo (Brazil)). 1987. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702560/JAW.

The iteration-subtraction method for the unified treatment of bound-state and scattering problems is compared and contrasted with a similar method for the two-body bound state problem via nonsingular scattering equations developed recently. It's also compared another recent method for solving bound state problems with the iteration-subtraction method.

29686 **(IFUSP-P—610) Extension of glauber theory to large angle scattering of 'Dirac' protons.** Hussein, M.S.; Marques, G.C.; Spehler, D. (Sao Paulo Univ. (Brazil). Inst. de Fisica; Strasbourg-1 Univ., 67 (France)). (Sao Paulo Univ. (Brazil). Inst. de Fisica). Nov 1986. 15p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702563/JAW.

The recently developed theory of the symmetrical T-matrix is extended here to the relativistic description of proton-nucleus scattering. The 4x4 symmetric T-matrix is reduced to an effective symmetric 2x2 matrix using projection technique. The resulting non-relativistic-looking T-matrix contains relativistic (virtual pair) effects to all orders. Glauber theory is then applied to develop a reasonable approximation which could be valid even at large angles.

29687 **(IFUSP-P—663) Isovector excitations of N not = Z nuclei.** Passos, E.J.V. de; Menezes, D.P.; Galeao, A.P.N.R. (Sao Paulo Univ. (Brazil). Inst. de Fisica; UNESP, Rio Claro (Brazil). Inst. de Geociencias e Ciencias Exatas). (Sao Paulo Univ. (Brazil). Inst. de Fisica). Sep 1987. 45p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702564/JAW.

We show that the method based on the tensor coupling of an appropriate family of isovector excitation operators to the parent isospin multiplet can be used, to advantage, for the correct treatment of the isospin degree of freedom in non isoscalar nuclei. This method is applicable to any isovector excitation operator and for parent states which need not to be of the closed subshells type. As an illustration we apply it to the study of the Gamow-Teller transition strength in ^{90}Zr.

29688 **(INIS-BR—974) Symplectic model for giant monopole resonances.** Oliveira, M.M.B.M. (Sao Paulo Univ. (Brazil). Inst. de Fisica). 1985. 91p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702569/JAW.

Following recently published articles, it's investigated how to apply the symplectic model to the study of giant monopole resonances in spherical nuclei. The results obtained agree with those already published for monopole mode energies, wave functions, radii and nuclear incompressibility of ^{16}O and ^{40}Ca nuclei. An analyse of how the spurious center-of-mass motion influence resonance energies is made. The sum rules of the monopole operator, m-bar /sub e/, o ≦ e ≦ 3, are calculated, demonstrating at first that they are conserved in the symplectic model. Then it's studied, for those sum rules, the importance of n-boson correlations in the fundamental state, which is an extension of those sum rules, of the analysis for the nuclear incompressibility, performed in above mentioned articles.

29689 **(INIS-BR—976) Application of hyperspherical formalism to the study of energy levels of three body systems submitted to Coulomb interaction.** Roditi, I. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1979. 88p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702571/JAW.

The results of the hyperspherical formalism aplication to the calculation of the H^- ions and the He atoms ground states is presented. It's shown that the value convergence is slow, as measured in the application of Nuclear Physics. This requires the calculation of higher rank matrix elements of the potential, for which the SCHOONSCHIP program of algebraic calculus was used. It's also necessary to use the method of convergence acceleration that improves remarkably the results of the direct application of the formalism.

29690 **(INIS-BR—996) (γ,2n) reactions in complexe nuclei at intermediate energies.** Pinheiro Filho, J. de D. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1976. 103p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88702580/JAW.

The Monte Carlo Method has been used in the intranuclear cascade model for the calculation of the cross sections of the (γ,2n) reactions in complex nuclei ^{9}Be, ^{12}C, ^{16}O, ^{59}Co, ^{103}Rh, ^{127}I, ^{197}Au and ^{209}Bi at intermediate energies (200MeV-1000MeV). The initial photon-interaction via the photomesonic and quasi-deuteron mechanisms have been taken into account. The nuclear model used was a degenerate Fermi gas of nucleons, and the Pauli exclusion principle was considered in all secondary interactions. To improve accuracy in the results of the calculations, 30000 cascades have been followed for each target nucleus at a given incident photon energy. The probabilities of the various (γ,2n) reactions, as well as the correspondent cross section obtained, are summarized in tables and graphs. New data on the cross sections of the ^{59}Co (γ,2n) and ^{209}Bi (γ,2n) reactions at photon energies between 300 MeV and 1000MeV are also reported. These measurements were obtained with the Bremsstrahlung beams of the Frascati 1 GeV Electron Synchrotron. A comparison between all existing data in the literature on the (γ,2n) reaction cross sections and the estimates by the Monte Carlo Method, is presented.

29691 **(LBL—24649) Nuclear and astrophysical evidence on the equation of state.** Glendenning, N.K. (Lawrence Berkeley Lab., CA (USA)). Jan 1988. Contract AC03-76SF00098. 9p. (CONF-880161—2).

From 16. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (18 Jan 1988).

Data on the nuclear equation of state from a number of different sources, from nuclei, high energy nuclear collisions, supernova and neutron stars is analyzed. The current situation concerning supernova simulations is critically appraised. It is found that simualtions that have achieved a prompt ejection do so with an equation of state that is too soft to support the measured masses of several known neutron stars. It is concluded that supernova explosions have not been proven to provide a significant constraint on the nuclear equation of state. Additionally it is concluded that the theoretical bias used to interpret data on neutron star masses as if they belonged to a population all having the same mass is unjustified. Evidence from the various nuclear data and neutron star masses favor a high compression modulus, K ~ 300 MeV. No definitive statement can be made about the equation of state at hgiher density,

save that the neutron star equation of state must be moderately stiff to accommodate neutron stars of mass ~ 1.85M. 29 refs., 1 fig.

29692 **Pre-equilibrium neutron emission in the nucleon exchange transport model.** Randrup, J.;Vandenbosch, R. (Lawrence Berkeley Lab., CA (USA). Nuclear Science Div.;Washington Univ., Seattle (USA). Dept. of Physics;Washington Univ., Seattle (USA). Dept. of Chemistry). *Nuclear Physics [Section] A;* 474: No. 1, 219-239(16 Nov 1987). Contract AC03-76SF00098;AC06-81ER40048.

We extend the nucleon exchange transport model to include the emission of pre-equilibrium neutrons as a result of nucleon transfer to unbound states. The treatment takes account of the heating of the two nuclei caused by the energy dissipation and the cooling due to the pre-equilibrium emission. Furthermore, the transferred nucleons may induce cascading in the receptor nucleus by means of direct two-body scattering with the resident nucleons, based on a reduced, Pauli-blocked, energy-dependent free NN cross section. Qualitative agreement with experimental data is achieved, but the absolute multiplicities are systematically underestimated by about a factor of two. The dependence of multiplicity on bombarding energy is reproduced. The energy spectra and their variation with angle are generally reproduced, although the yield of the highest energy particles is sometimes underestimated.

29693 **Coherent effects in highly excited nuclei: Proceedings.** Wilhelmi, Z.;Szeflinska, G. (eds.). New York, NY; Harwood Academic Publishers (1987). 413p. (CONF-8609190—). Harwood Academic Publishers, GmbH, Poststrasse 22, 7000 Chur, Switzerland $65.00.

From 18. Mikolajki summer school on nuclear physics; Mikolajki, Poland (1 Sep 1986).

The proceedings contain contributing papers on related topics of coherent properties of highly excited nuclei. The titles of these papers are: The Deformation of Rotating Nuclei;The Multiphonon Method as a Dynamical Approach to Octupole Correlations in Deformed Nuclei;The Proton-Neutron Interaction and Nuclear Structure;The Excitation of Actinide Nuclei;Relativistic Mean-Field Theories and Nuclear Properties;Studies of Isovector Excitations in Nuclei by Neutron-Induced Reactions;Complex Fragment Emission at Low and High Excitation Energy;Experimental Studies of the Reaction Mechanism of Incomplete Fusion;Recoil Range Studies of Reaction Mechanisms;Inner Shell Ionization Accompanying Nuclear Collisions;Anomalous Conversion-Electron Intensity Ratio of the EO Transitions in Gadolinium 154;Chiral Asymmetry in Nuclear Beta Decay;and The Physics of Uniformly Accelerated Relativistic Motion. (LSP)

6540 Radiation And Shielding Physics

REFER ALSO TO CITATION(S) 29340, 29389

29694 **(CONF-870610—20) PHOTON: A program for synchrotron radiation dose calculations.** Chapman, D.; Gmeur, N.; Lazarz, N.; Thomlinson, W. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 12p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88007676/JAW.

From 5. national synchrotron radiation instrumentation conference; Madison, WI, USA (21 Jun 1987).

A computer program, PHOTON, has been developed to calculate radiation levels associated with a general synchrotron beamline arrangement. PHOTON calculates the transmitted an scattered spectra as the synchrotron beam passes through sequential filters. The Compton component of this scattered radiation can then be passed through a series of materials composing a shielding wall. This radiation can then be used to calculate a dose in a medium outside of the shielding wall. Program input is such that the sequence of operations is easily followed and modified for any beamline configuration. Measurements have been performed by Elke Braueer on existing NSLS beamlines in various geometries. Good agreement between calculated and measured dose values was found in all cases. This agreement implies that results obtained for shielding of sources containing a wide range of energies, such as that of the NSLS High Field Supercodnucting Wiggler are correct.

29695 **(CONF-8703156—2) The development of KENO and the calculation of differential parameters with KENO.** Whitesides, G.E. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 6p.

From Workshop on the influence of neutron spectra on experimental measurements; Tucson, AZ, USA (23 Mar 1987).

This paper is designed to review the origin of the KENO program, to discuss its development, to explain some reasons for its form and capabilities, and lastly, to comment on the codes capability relative to the subject of this meeting, namely neutron spectra. The original programming, which was later to become KENO, was nothing more than a few energy groups, fixed-source calculation of neutron leakage, and absorption in a right circular cylinder. Its sole purpose initially was to be used to evaluate the capabilities of several computers with regard to performing Monte-Carlo-type calculations. This original program grew to a fission source iteration that was used to evaluate single, cylindrical uranium metal units being studied by J.T. Thomas. This development was followed by providing the capability to treat arrays of cylindrical units, which was also a part of the Thomas' experimental studies. 7 refs.

29696 (DOE/ER/60402—1, pp 29-32) **Effects of nuclear reaction mechanisms on high-energy neutron kerma factors for carbon.** Brenner, D.J.; Zaider, M. Jul 1986. NTIS, PC A05/MF A01. Order Number DE86013991/JAW.

In Radiation physics, biophysics, and radiation biology. Progress report, December 1, 1985-November 30, 1986.

Kerma factors are crucial in neutron radiotherapy to convert the output of an ionization chamber into a dose in tissue, allowing intercomparison between different facilities. The most recent major evaluation of neutron-carbon cross sections was made in 1978 for the latest version of the Evaluation Neutron Data File (ENDF/B-V). However considerable evidence has recently accrued to indicate that there may be major discrepancies in this evaluation at 14 MeV and above. As the sixth version of ENDF is several years away, and kerma factors are required immediately, it is timely to call attention to this issue. The kerma factor for carbon (kinetic energy released to charged particles per unit mass per unit fluence), requires knowledge not only of the integrated cross section, but also of the emitted charged-particle-energy spectra. Thus, detailed reaction mechanisms or, equivalently, complete secondary charged-particle spectra must be known.

29697 (DOE/ER/60402—1, pp 36-39) **Measurement of doubly differential cross sections for electron emission from collisions of 1.3 to 4 MeV oxygen ions incident on water vapor.** Goldhagen, P.E. Jul 1986. NTIS, PC A05/MF A01. Order Number DE86013991/JAW.

In Radiation physics, biophysics, and radiation biology. Progress report, December 1, 1985-November 30, 1986.

This laboratory has begun a collaboration with the Pacific Northwest Laboratory to produce accurate Monte Carlo calculations of energy deposition patterns and microdosimetric quantities in tissue for neutrons with energies above a few MeV. When fast neutrons such as those used in radiotherapy or produced in d-t fusion are absorbed in tissue, heavy recoil ions (carbon, oxygen, and others) are produced as well as protons and helium ions. Although recoil protons dominate energy absorption, heavy recoils can produce large specific-energy depositions, so they may contribute significantly to radiobiological effects. Detailed calculations of energy deposition patterns from recoil ions require comprehensive information about their interaction with the absorbing medium. Although considerable data exist for protons and helium ions, little is available regarding the interactions of heavier charged particles with biologically relevant material. To begin to provide such data, the authors have measured the energy and angular distributions of electrons ejected in collisions of O^+, O^{3+}, and O^{3*} ions with water molecules.

29698 (DOE/ER/60402—1, pp 40-43) **Reflections at the birth of nanodosimetry.** Zaider, M.; Brenner, D.J. Jul 1986. NTIS, PC A05/MF A01. Order Number DE86013991/JAW.

In Radiation physics, biophysics, and radiation biology. Progress report, December 1, 1985-November 30, 1986.

It has become increasingly clear in the past several years that in order to completely characterize the stochastics of energy deposition in biological materials one needs microdosimetric measurements in a series of volumes ranging in size from nm to μm. Thus in a recent paper it was proposed that in a first approximation, microdosimetric spectra in two spherical sites (6 nm and 1 m diameter) could be combined to reproduce the cellular inactivation cross sections as measured by Todd. This statement can be further generalized to arbitrary biological response and also to obtain proximity functions from measurements of the quantity y/sub D/.

29699 (DOE/ER/75172—5, pp 68-71) **Evaluation of boron carbide coatings.** Levinskas, D. (Idaho State Univ., Pocatello (USA)). 1987. NTIS, PC A06/MF A01. Order Number DE88005041/JAW. (CONF-8703231—Summs.).

From Western region American Nuclear Society student conference: nuclear technology for the year 2000; Albuquerque, NM, USA (19 Mar 1987).

A method of depositing pure boron carbide directly onto various metal surfaces has recently been developed by Lynn Industrial Coatings Inc. of Boise, Idaho. The coating may provide design engineers with a new material form for criticality control in spent fuel shipping casks and storage pools. the AGN-201 reactor at Idaho State University was used to determine the neutron attenuation characteristics of boron carbide applied as a thin coating over a metal surface. Initial results indicate that boron carbide coatings as thin as 0.040 inches will attenuate 90% of an incident thermal neutron beam. The neutron attenuation experiment and resulting data are described. The coating density, calculated from the data obtained in the attenuation experiment, is compared to the density given for boron carbide in standard references. The advantages of directly coating structural materials as a means of achieving criticality control, instead of the current practice of using boron loaded aluminum plate, are examined. The possibility of using boron carbide coatings in a number of nuclear applications are suggested.

29700 (SAND—87-1330) **Measurement of neutron spectra in varied environments by the foil-activation method with arbitrary trials.** Kelly, J.G.;Vehar, D.W. (Sandia National Labs., Albuquerque, NM (USA)). Dec 1987. Contract AC04-76DP00789. 186p.

Neutron spectra have been measured by the foil-activation method in 13 different environments in and around the Sandia Pulsed Reactor, the White Sands Missile Range Fast Burst Reactor, and the Sandia Annular Core Research Reactor. The spectra were obtained by using the SANDII code in a manner that was not dependent on the initial trial. This altered technique is better suited for the determination of spectra in environments that are difficult to predict by calculation, and it tends to reveal features that may be biased out by the use of standard trial-dependent methods. For some of the configurations, studies have also been made of how well the solution is determined in each energy region. The experimental methods and the techniques used in the analyses are thoroughly explained. 34 refs., 51 figs., 40 tabs.

29701 **Experimental measurement of metal multilayer x-ray reflectivity degradation due to intense x-ray flux.** Hockaday, M.Y. Las Cruces, NM; New Mexico State Univ. (1986). 257p. University Microfilms Order No. 87-09,675.

Thesis (Ph. D.).

The degradation of the x-ray reflection characteristics of metal multilayer Bragg diffractors due to intense x-ray flux was investigated. The Z-pinch plasma produced by PROTO II of Sandia National Laboratories, Albuquerque, New Mexico, was used as the source. The plasma generated total x-ray yields of as much as 40 kJ with up to 15 kJ in the neon-, hydrogen-, and helium-like resonance lines in nominal 20-ns pulses. Molybdenum-carbon, palladium-carbon, and tungsten-carbon metal multilayers were placed at 50 and 150 cm from the plasma center. The multilayers were at nominal angels of 5° and 10° to diffract the neon resonance lines. The time-integated x-ray reflection of the metal multilayers was monitored by x-ray film. Data for two separate shots were analyzed. For a pure neon gas shot at a power level of 420 TW, the reflectivity of the multilayer at 15 cm decayed rapidly with respect to the still-rising signal of the multilayer at 150 cm. The onset time of the decay corresponded to an integrated dose of 5.27 J/cm². For a neon implosion onto a vanadium-doped polyacrylic acid foam target shot, detailed modeling was attempted. The spectral flux was determined with data from 5 XRD channels and deconvolved using the code SHAZAM. The observed decay in reflectivity was assumed to correspond to the melting of the first tungsten layer.

6550 Medical Physics

REFER ALSO TO CITATION(S) 29386, 29396

29702 (DOE/ER/60402—1, pp 33-35) **Neutron microdosimetry at RARAF.** Kliauga, P. Jul 1986. NTIS, PC A05/MF A01. Order Number DE86013991/JAW.

In Radiation physics, biophysics, and radiation biology. Progress report, December 1, 1985-November 30, 1986.

A comprehensive series of measurements of neutron microdosimetry spectra is underway at the RARAF facility. The neutrons generated at RARAF are semi-monoenergetic to monoenergetic, depending on energy. Thus far, measurements have concentrated on 15 MeV, with a few measurements done at 6 MeV. One of the main reasons for undertaking this project is dissatisfaction with the state of accuracy of microdosimetric measurements of neutrons, not only previous measurements done at RARAF, but reports in the literature from all over the world. Only a relatively modest amount of data has been taken for neutrons, as compared to photons, and the survey of dose mean lineal energy values done for the recent ICRU Report No. 36 (December 1983) reveals a spread of values far in excess of accepted estimates of statistical uncertainty (5-10%). One of the major motivations in undertaking this project, therefore, was to elucidate some of the factors, including experimental artifacts, which are important in contributing to systematic errors in measurements. Among the methods being employed are determination of the effect of various counter parameters on neutron spectra, and electronic parameters, also. Another important method of obtaining information is a comparison between different counters. This laboratory has access to perhaps a greater variety of microdosimetric proportional counters than any in the world, from the standard Rossi counter, to various wall-less types of differing geometries. Controlled comparisons of spectra from such differing counters using the same analysis technique can yield much information on the effect of counter geometry on the microdosimetric spectrum.

29703 (DOE/ER/60402—1, pp 45-48) **Microdosimetric calculations in objects with realistic cellular geometries.** Brenner, D.J.; Zaider, M.; Geard, C.R.; Chen, C.Y. Jul 1986. NTIS, PC A05/MF A01. Order Number DE86013991/JAW.

In Radiation physics, biophysics, and radiation biology. Progress report, December 1, 1985-November 30, 1986.

Microdosimetric calculations have traditionally been performed in spherical sites. Plated cells are distinctly non-circular in projection. Thus various authors have examined distributions for spheroids, and distributions for hemispheroids. However the elliptical projection of a spheroid, uniquely determines its height, an unrealistic situation for plated cells whose heights are independent of their other dimensions. Thus it appears desirable to calculate microdosimetric distributions in right elliptical cylinders, where the height is independent of the diameter and eccentricity. This paper discusses these calculations.

29704 (INFO—0165) **Derivation of release limits for a typical uranium mining and milling facility.** (Atomic Energy Control Board, Ottawa, Ontario (Canada); Beak Consultants Ltd., Toronto, Ontario (Canada)). Sep 1985. 199p. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88702566/JAW.

This report develops guidelines for calculating derived release limits (DRLs) for releases of each radionuclide belonging to the uranium-238 and thorium-232 decay chains to atmosphere, surface water and groundwater from uranium mining and milling operations in Canada. DRLs are defined as calculated limits on releases from the facility that result in radiation exposures through all environmental pathways equal to the annual effective dose equivalent limit of 0.005 Sv for stochastic effects or the annual dose equivalent limit of 0.05 Sv for non-stochastic effects in the critical group. By

definition, DRLs apply to controllable radionuclide emissions which occur during the operational phase of mine/mill facilities. The report develops a steady-state environmental transfer model to determine environmental dilution and dispersion in atmosphere, surface water and groundwater between the sources at the mine and mill and the critical group receptor. Exposure pathways incorporated in the model include external exposure from immersion in the airborne plume, immersion in water, contaminated ground and contaminated shoreline sediments. Internal exposure pathways include inhalation of contaminated air and ingestion of contaminated water and terrestrial and aquatic foods.

6560 Condensed Matter Physics

REFER ALSO TO CITATION(S) 29178, 29207, 29600

29705 **(CBPF-NF—014/86) Saxs study of silica aerogels.** Craievich, A.F.; Aegerter, M.A.; Santos, D.I. dos; Woignier, T.; Zarzycki, J. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro; Sao Paulo Univ., Sao Carlos, SP (Brazil). Inst. de Fisica e Quimica; Montpellier-2 Univ., 34 (France)). (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1986. 34p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702488/JAW.

Aerogels produced by hypercritical drying of gels from hydrolysis of TMOS (Tetramethoxysilane) in various pH conditions and subjected to a densification process were studied by SAXS using LURE synchrotron facility. The evaluation of scattering data combined with BET measurements leads to a model of aerogels consisting of a light density matrix in which meso-and macro-pores are embedded.

29706 **(IC—87/76) Dynamic local field factor of a uniform electron liquid.** Mukhopadhyay, G. (International Centre for Theoretical Physics, Trieste (Italy)). May 1987. 30p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702511/JAW.

We present an expression for the dynamic local field factor of a uniform interacting electron liquid, as G(q-tilde,ω)=G_1(q-tilde)+G_2(q-tilde,ω), where G_1 is the static field factor of the STLS-theory, and G_2 has a structure similar to that obtainable from the mode-coupling theory of the Memory-function approach. The q -> 0 limit of the imaginary part of G, which is of interest in the time-dependent Local-density-functional theory, has the correct $\omega^{-3}2$ dependence, and yields the long-wavelength plasmon damping coefficient in good agreement with diagramatic calculations as well as the mode-coupling approach, detailed numerical results are also presented. (author). 24 refs, 8 figs.

29707 **(IC—87/77) Decay of Wannier-Mott excitons interacting with acoustic phonon in semiconductors with a degenerate valence band.** Nguyen Toan Thang; Nguyen Ai Viet; Nguyen Hong Quang. (International Centre for Theoretical Physics, Trieste (Italy); Academy of Science of Vietnam, Hanoi (Vietnam). Inst. of Theoretical Physics). (International Centre for Theoretical Physics, Trieste (Italy)). Jun 1987. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702512/JAW.

Decay probabilities of light and heavy excitons interacting with acoustic phonons in cubic semiconductors with a degenerate valence band are calculated. The numerical results for GaAs showed that the decay probability of the light exciton is much greater than that of the heavy one. (author). 10 refs, 1 fig.

29708 **(IC—87/78) Interband electronic Raman scattering of polarized light in cubic semiconductors with degenerate valence bands.** Nguyen Toan Thang; Nguyen Ai Viet; Nguyen Hong Quang. (International Centre for Theoretical Physics, Trieste (Italy); Academy of Science of Vietnam, Hanoi (Vietnam). Inst. of Theoretical Physics). (International Centre for Theoretical Physics, Trieste (Italy)). Jun 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702513/JAW.

The cross-sections are calculated for the Raman scattering processes with polarized light in cubic semiconductors where the valence band top is fourfold degenerate Γ_8. The exciton effect is taken into account. (author). 17 refs.

29709 **(IC—87/79) Fine structure and energy spectrum of exciton in direct band gap cubic semiconductors with degenerate valence bands.** Nguyen Toan Thang; Nguyen Ai Viet; Nguyen Que Huong. (International Centre for Theoretical Physics, Trieste (Italy); Academy of Science of Vietnam, Hanoi (Vietnam). Inst. of Theoretical Physics). (International Centre for Theoretical Physics, Trieste (Italy)). Jun 1987. 15p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702514/JAW.

The influence of the cubic structure on the energy spectrum of direct exciton is investigated, using the new method suggested by Nguyen Van Hieu and co-workers. Explicit expressions of the exciton energy levels 1S, 2S and 2P are derived. A comparison with the experiments and the other theory is done for ZnSe. (author). 10 refs, 1 fig., 2 tabs.

29710 **(IC—87/80) Theory of two-photon absorption by exciton states in cubic semiconductors with degenerate valence bands.** Nguyen Ai Viet; Nguyen Toan Thang. (International Centre for Theoretical Physics, Trieste (Italy)). Jun 1987. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702515/JAW.

The coefficient of the absorption of two polarized photons is calculated for direct band gap semiconductors with degenerate valence bands. Wannier-Mott exciton states are included in both the intermediate and final states. Numerical calculations are performed for ZnSe and are compared with Sondergeld's experimental and theoretical results. (author). 11 refs, 2 tabs.

29711 **(IC—87/81) Study of relaxation processes and uniaxial anisotropy in the Europium Gallium Garnet epitaxial films.** Mukhopadhyay, P. (International Centre for Theoretical Physics, Trieste (Italy)). Apr 1987. 16p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702516/JAW.

We report here the magnetic properties of Europium-Gallium Garnet LPE films of the type Eu/sub x/Y/sub 3-x/Fe/sub 5-y/Ga/sub y/O_{12} (where O<x<1.2 and 1<y<1.1). The mechanism by which the magnetic moments relax in Eu or Sm Garnets is still not fully understood. We have made studies on Eu-Ga garnet films and explain some of the results observed in these films. Pb and Pt ions are always found as impurities in our films. Pb ions contribute to the anisotropy in the film. Most of the experimental results can be explained with the three sub lattice model. The shape of the FMR line width shows strong sensitivity towards the surface impurities. (author). 18 refs, 6 figs, 1 tab.

29712 **(IC—87/88) Plasmon sidebands in the gain spectrum of an electron-hole plasma.** Hoang Ngoc Cam; Nguyen Van Hieu; Nguyen Ai Viet. (International Centre for Theoretical Physics, Trieste (Italy)). Jun 1987. 27p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702523/JAW.

The theory is represented for the recombination of the electron-hole pair into the photon with and without the emission of the plasmon-phonon coupled modes. In calculating the energies of the plasmon and the plasmon-phonon coupled modes as well as the vertices of their effective interactions the quantum field theory method has been applied. The theoretical prediction agrees well with the experimental result in the main part EHP_0 and the first sideband EHP$\sqrt{}$ of the gain spectrum. (author). 6 refs, 9 figs.

29713 **(IEN-DIAPQ—01/84) Manganite from Conquista, Bahia State, Brazil.** Baptista, A. (Instituto de Engenharia Nuclear, Rio de Janeiro (Brazil)). Feb 1984. 13p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702556/JAW.

Samples of manganite ore, γ-MnO(OH) from Ilfeld, Harz, Germany and Conquista, in Bahia - Brazil, were studied by radiocrystallographic and thermal methods. The crystallization system of the mineral was determined by mono-crystal study and the decom-

position process of manganite was analysed by thermo-differential and thermogravimetric studies. (M.C.K.).

29714 **(INIS-BR—949) Density of states in Mo-Ru amorphous alloys.** Miyakawa, W. (Sao Paulo Univ. (Brazil). Inst. de Fisica). 1985. 89p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702567/JAW.

The density of states is calculated for several compositions of amorphous Mo/sub 1-x/ Ru/sub x/. In order to simulate amorphous clusters, the structures (atomic positions) utilized in the calculations were built from a small dense randomly packed unit of hard spheres with periodic boundary conditions. The density of states is calculated from a tight-binding Hamiltonian with hopping integrals parametrized in terms of the ddσ, ddPI and ddδ molecular integrals. The results for pure Mo and pure Ru, compared in the canonical band aproximation, agree well with the literature. For binary alloys, the comparison of the calculated density of states with the rigid band aproximation results indicates that a more complex approach than the rigid band model must be used, even when the two atoms have similar bands, with band centers at nearly the same energy. The results also indicate that there is no relation between the peak in the superconducting critical temperature as a function of the number of valence eletrons per atom (ea) in the region near Mo(ea=6) and the peak of the density of states at the Fermi level in the same region, as has been sugested by some authors.

29715 **(INIS-BR—995) Anisotropic Heisenberg model for a semi-infinite crystal.** Queiroz, C.A. (Santa Catarina Univ., Florianopolis (Brazil)). Nov 1985. 108p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88702579/JAW.

A semi-infinite Heisenberg model with exchange interactions between nearest and next-nearest neighbors in a simple cubic lattice. The free surface from the other layers of magnetic ions, by choosing a single ion uniaxial anisotropy in the surface (Ds) different from the anisotropy in the other layers (D). Using the Green function formalism, the behavior of magnetization as a function of the temperature for each layer, as well as the spectrum localized magnons for several values of ratio Ds/D for surface magnetization. Above this critical ratio, a ferromagnetic surface layer is obtained white the other layers are already in the paramagnetic phase. In this situation the critical temperature of surface becomes larger than the critical temperature of the bulk.

29716 **(IS-T—1286) Theoretical investigations of phonon anomalies in fcc La and W(001).** Wang, Xuewen. (Ames Lab., IA (USA)). 1987. Contract W-7405-ENG-82. 89p. NTIS, PC A05/MF A01; GPO Dep. Order Number DE88007348/JAW.

Studies of the electron-phonon interaction were carried out for fcc La by the efficient tight-binding method. This scheme was then extended and generalized to surface studies. Application of this extended scheme to the W(001) surface provided detailed information about the driving mechanism for surface reconstruction. Together with the further studies on the Mo(001) surface, our investigation showed very promising potential applications of this scheme to various surface phonon and surface phase transition studies. For the fcc La, first-principles pseudopotential band-structure calculations were performed and revealed a small but sharp nesting feature of the Fermi surface. Then the non-orthogonal tight binding parameters were derived from the first-principles results and latice dynamics calculations were carried out with the tight-binding scheme. The calculated phonon dispersion curves showed very good agreement with neutron scattering data. Our detailed analysis revealed the crucial role played by d-electron, the speculated role of the f-levels contribution was clarified, and the phonon spectrum under high pressure (>50 Kbar) was predicted. The unique properties of fcc La, for example, the negative thermal expansion coefficient and relatively high superconducting temperature, were explained in terms of the anomalously strong electron-phonon coupling. Also, the possible connection with the interesting phase transformation observed at high pressure was explored. The calculations for W(001) p(1 x 1) surface phonons successfully demonstrated the electronic origin of the c(2 x 2) surface reconstruction. 54 refs., 18 figs., 5 tabs.

29717 **Multiple scattering and the 200 reflection in silicon and germanium.** Tischler, J.Z.;Budai, J.D.;Ice, G.E.;Habenschuss, A. (Oak Ridge National Lab., TN (USA). Solid State Div.;Oak Ridge National Lab., TN (USA). Metals and Ceramics Div.;Oak Ridge Associated Universities, Inc., TN (USA)). *Acta Crystallographica, Section A: Foundations of Crystallography;* **44**: No. 1, 22-25(1 Jan 1988). Contract AC05-84OR21400.

Absolute measurements of the 200 reflection in Si and Ge at various azimuthal orientations are compared with N-beam calculations of the integrated intensity. All of the non-zero integrated intensity is accounted for by multiple-beam scattering. The measurements match the calculations on the assumption that $F_{200}=0$.

6561 Superconductivity

REFER ALSO TO CITATION(S) 29210, 29224, 29229, 29231, 29232, 29233, 29234, 29235

29718 **(IC—87/179) Fluctuations of order parameters in the high T/sub c/ superconductors.** Das, M.P.; Saif, A.G. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1987. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702549/JAW.

Recently we have proposed a phenomenological approach in terms of two coexisting macroscopic order parameters corresponding to the superconducting and insulating states and have discussed the electrodynamical responses of the superconducting ceramics. In this paper we discuss the fluctuations of the order parameters both in the static and in the dynamical situations in the mean field approach and obtain results for the electrical conductivity which possesses anomalies as in granular materials. (author). 22 refs.

6570 Theoretical And Mathematical Physics

REFER ALSO TO CITATION(S) 29583, 29652

29719 **(CBPF-NF—054/87) Spin-glass in low dimension and the Midgal Kadanoff approximation.** Curado, E.M.F.; Meunier, J.-L. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro; Nice Univ., 06 (France)). (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. 31p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702499/JAW.

We study the spin glass problem within the Migdal Kadanoff approximation of the hyper cubic lattices. Using various technics, both analytical and numerical, we perform the real space renormalization of the problem. We find that a Spin Glass transition occurs in 3 dimensions while it does not occur in two dimensions. The specific heat critical exponent for the transition is found to be large and negative in agreement with the experimental results.

29720 **(IC—87/82) BRS algebra of a free differential algebra.** Boukraa, S. (International Centre for Theoretical Physics, Trieste (Italy)). Apr 1987. 31p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702517/JAW.

We construct in this work, the Weil and the universal BRS algebras of theories that can have as a gauge symmetry a free differential (Sullivan) algebra, the natural extension of Lie algebras allowing the definition of p-form gauge potentials (p>1). The finite gauge transformations of these potentials are deduced from the infinitesimal ones and the group structure is shown. The geometrical meaning of these p-form gauge potentials is given by the notion of a Quillen superconnection. (author). 19 refs.

29721 **(IC—87/84) Boundary element solution of the transonic integro-differential equation involving a decay function.** Ogana, W. (International Centre for Theoretical Physics, Trieste (Italy)). Jun 1987. 27p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702519/JAW.

The transonic integro-differential equation is solved using a decay function which can be applied in front and aft of the airfoil

rather than on the airfoil surface only. The computational domain is discretized into rectangular elements and the integrals involving the dependent variable are approximated by boundary element methods in each rectangle. Besides constant elements, use is made of hybrid elements which are based on constant elements in the streamwise direction and variable elements in the transverse direction. The matrix elements are computed once and stored but the described method leads to considerable savings in storage space. The methods are tested for parabolic-arc and NACA0012 airfoils in subcritical and supercritical flows and the results compare well with finite difference solutions. It is concluded that hybrid elements provide good accuracy even with only one horizontal strip of rectangular elements, which implies a relatively small number of nodes. (author). 18 refs, 6 figs, 3 tabs.

29722 **(IC—87/85) Boundary element solution of the transonic integral equation.** Ogana, W. (International Centre for Theoretical Physics, Trieste (Italy)). Jun 1987. 29p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702520/JAW.

In this paper we solve the two-dimensional transonic integral equation by boundary element methods. We use constant and quadrilateral elements but we also develop hybrid elements based on constant elements in the streamwise direction and variable elements in the transverse direction. The methods are tested for parabolic-arc and NACA0012 airfoils. Although solutions converge fast and require a small number of nodes, the results compare well with finite difference solutions obtained from a larger number of nodes. The hybrid elements are recommended because they yield results which are more accurate than constant elements, without the computational complexity associated with quadrilateral elements. In addition, they can be applied with reasonable accuracy, using one strip of rectangular elements, hence a small number of nodes. (author). 18 refs, 5 figs, 3 tabs.

29723 **(IC—87/86) Boundary element solution of the transonic integro-differential equation.** Ogana, W. (International Centre for Theoretical Physics, Trieste (Italy)). Jun 1987. 34p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702521/JAW.

The transonic integro-differential equation for two-dimensional flows is solved by boundary element methods. In addition to constant and quadrilateral elements we develop hybrid elements based on constant elements in the streamwise direction and variable elements in the transverse direction. Computation is carried out for parabolic-arc and NACA0012 airfoils and the results, which converge fast, compare favourably with finite-difference solutions. The hybrid elements are to be preferred because they yield results which are more accurate than constant elements without the computational complexity associated with quadrilateral elements. Moreover, they can be applied with a small number of nodes by using only one strip of rectangular elements. (author). 18 refs, 7 figs, 4 tabs.

29724 **(IC—87/87) Transonic integro-differential and integral equations with artificial viscosity.** Ogana, W. (International Centre for Theoretical Physics, Trieste (Italy)). Jun 1987. 23p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702522/JAW.

From the two-dimensional transonic small disturbance equation, with artificial viscosity, we derive an integro-differential equation and subsequently an integral equation. The computational domain is discretized into rectangular elements and functions of the dependent variable and its derivatives are assumed to be constant in each element. The resulting nonlinear algebraic systems are solved by Jacobi iteration. The method is tested for parabolic-arc and NACA0012 airfoils. Convergence is fast and the solutions compare well with finite-difference results, despite the use of a comparably small number of nodes. (author). 18 refs, 7 figs.

29725 **(IC—87/95) Harmonic maps, twistor spaces and twistor lifts.** Jensen, G.R. (Washington Univ., St. Louis, MO (USA). Dept. of Mathematics). (International Centre for Theoretical Physics, Trieste (Italy)). May 1987. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702530/JAW.

This paper describes the geometry of the twistor space of a 4-manifold and also the relation of twistor lifts to study harmonic maps from Riemann surfaces into four manifolds. (author). 21 refs.

29726 **(IC—87/96) Puzzling entanglement of Schroedinger's wave function.** Ghirardi, G.C.; Rimini, A.; Weber, T. (International Centre for Theoretical Physics, Trieste (Italy); Pavia Univ. (Italy). Ist. di Fisica Nucleare; Trieste Univ. (Italy). Ist. di Fisica Teorica). (International Centre for Theoretical Physics, Trieste (Italy)). May 1987. 39p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702531/JAW.

A brief review of the conceptual difficulties met by the quantum formalism is presented. The main attempts to overcome these difficulties are considered and their limitations are pointed out. A recent proposal based on the assumption of the occurrence of a specific type of wave function collapse is discussed and its consequences for the above-mentioned problems are analyzed. (author). 28 refs.

29727 **(IC—87/98) Index of a holomorphic flow with an isolated singularity.** Verjovsky, A.; Gomez-Mont, X.; Seade, J. (International Centre for Theoretical Physics, Trieste (Italy); Universidad Nacional Autonoma de Mexico (Mexico). Inst. de Matematicas). (International Centre for Theoretical Physics, Trieste (Italy)). May 1987. 19p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702533/JAW.

The index of a holomorphic vector field Z defined on a germ of a hypersurface V with an isolated singularity is defined. The index coincides with the Hopf index in the smooth case. Formulae for the index in terms of the ideals defining Z and V are given. Topological invariance of the index and the Chern class as well as formulae relating global invariants of the Poincare-Hopf type are proven. (author). 26 refs.

29728 **(IC—87/105) Directionally critical values and mountain pass theorem.** Duong Minh Duc. (International Centre for Theoretical Physics, Trieste (Italy)). Jun 1987. 15p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702540/JAW.

In this paper we define the directional differentiability along a vector subspace and prove the mountain pass theorem for D-differentiable functionals on a subset of a Banach space. (author). 12 refs.

29729 **(IC—87/108) Differentiability of Uryson operators and their applications.** Duong Minh Duc. (International Centre for Theoretical Physics, Trieste (Italy)). Jun 1987. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702543/JAW.

In order to use the variational method for non-Frechet-differentiable functional, we find the conditions of the directional differentiability of Uryson operators, and apply to solve a general boundary value problem. (author). 5 refs.

29730 **(IC—87/182) K-Kolmogorov duality theorem.** Abd El-Sattar, A. Dabbour. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702551/JAW.

The K-Kolmogorov cohomology construction /sub H//sup k/ over a pair of discrete coefficient groups is given and discussed from the point of view of Eilenberg-Steenrod's axiom of the cohomology theory. This construction has many points of contiguity with other cohomology groups. The K-Kolmogorov cohomology groups on a pair of compact groups have been topologized by using their duality with the K-Kolmogorov homology groups. In the present work the Kolmogorov duality theorem is proved for /sub H//sup k/. 11 refs.

29731 **(IC—87/183) Invariant Kaehlerian metrics on C/sup n/.** Azad, H. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1987. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702552/JAW.

We determine Kaehlerian metrics on C/sup n/ which are invariant under the unitary group, give a criterion for their completeness and determine those which are Ricci flat. (author). 11 refs.

29732 **(LA—11276-MS) Theoretical basis for an experimental test with regard to the origin of VHF [very high frequency] radiation from natural lightning.** Mondt, J.P. (Los Alamos National Lab., NM (USA)). May 1988. Contract W-7405-ENG-36. 26p.

The VHF radiation from a return stroke is knone to commence only several tens of micriseconds after the electrostatic field change caused by the return stroke. One long-held interpretation of this delay restricts the emission to the in-cloud portion of the return stroke. This interpretation correlates positively with reports on laboratory observations of UHF and VHF radiation associated with corona breakdown of droplets. On the other hand, a recent study shows that an apparent delay of VHF radiation from return strokes should be expected on the basis of ground-wave attenuation. However, the study does not settle the question of the very existence of attenuated signals from low altitude commensurate with the source strength inferred from higher, i.e., unattenuated, portions of the return stroke. The purpose of this report is to provide the theoretical basis and motivation for a quantitative determination of VHF radiation from the lower portion of the return stroke. A conclusive experiment would reveal whether the VHF radiation from return strokes is primarily caused by corona breakdown of water droplets or rather by processes operative in dry air as well. 15 refs., 4 figs.

29733 **(UWThPh—1987-34) Groups of automorphisms of the canonical commutation and anticommutation relations.** Grosse, H.; Pittner, L. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik; Graz Univ. (Austria). Inst. fuer Theoretische Physik). (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1987. 19p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702618/JAW.

Observables of supersymmetric quantum mechanics are coded by taking the antisymmetric tensor product with anticommuting parameters. Next we define superunitary transformations, which mix bosonic and fermionic degrees of freedom, in order to construct automorphisms of the canonical (anti-) commutation relations. Conversely, every automorphism of the C(A)CR is implemented by an essentially unique superunitary transformation. 12 refs.

29734 **(UWThPh—1987-48) Transitivity and ergodicity of quantum systems.** Narnhofer, H.; Thirring, W.; Wiklicky, H. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1987. 19p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702625/JAW.

First we try to generalize the notion of a topological transitive or a topologically mixing system for quantum mechanical systems in a consistent way. Furthermore we compare these ergodic properties with the classical results. Finaly we deal with some aspects of nearly abelian systems and investigate some relations between these notions. 11 refs.

29735 **(UWThPh—1987-50) Stochastic quantum gravity.** Rumpf, H. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1987. 18p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702626/JAW.

We begin with a naive application of the Parisi-Wu scheme to linearized gravity. This will lead into trouble as one peculiarity of the full theory, the indefiniteness of the Euclidean action, shows up already at this level. After discussing some proposals to overcome this problem, Minkowski space stochastic quantization will be introduced. This will still not result in an acceptable quantum theory of linearized gravity, as the Feynman propagator turns out to be non-causal. This defect will be remedied only after a careful analysis of general covariance in stochastic quantization has been performed. The analysis requires the notion of a metric on the manifold of metrics, and a natural candidate for this is singled out. With this a consistent stochastic quantization of Einstein gravity becomes possible. It is even possible, at least perturbatively, to return to the Euclidean regime. 25 refs.

29736 **Wave chaos in the stadium: Statistical properties of short-wave solutions of the Helmholtz equation.** McDonald, S.W.;Kaufman, A.N. (Physics Department and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review [Section] A: General Physics;* 37: No. 8, 3067-3086(15 Apr 1988). Contract AC03-76SF00098.

We numerically investigate statistical properties of short-wavelength normal modes and the spectrum for the Helmholtz equation in a two-dimensional stadium-shaped region. As the geometrical optics rays within this boundary (billiards) are nonintegrable, this wave problem serves as a simple model for the study of quantum chaos. The local spatial correlation function <psi/sub n/(x+(12s)psi/sub n/(x- 1) 2 s)> and the probability distribution P/sub n/(psi) of wave amplitude for normal modes psi/sub n/ are computed and compared with predictions based on semiclassical arguments applied to this nonintegrable Hamiltonian. The spectrum is analyzed in terms of the probability P(ΔE) of neighboring energy-eigenvalue separations, which is shown to be similar to a Wigner distribution for the eigenvalues of a random matrix.

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29737 **(AD-A—188228/1/XAB) Analysis of whistler-mode radiation from the Spacelab-2 electron beam. Revision. Progress report.** Farrell, W.M.; Gurnett, D.A.; Banks, P.M.; Bush, R.I.; Raitt, W.J. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). 7 Aug 1987. 42p. (U.OF-IOWA—87-19-REV). NTIS, PC A03/MF A01.

Revision of report dated Jan 1987.

During the shuttle's Spacelab-2 mission, the Plasma Diagnostics Package (PDP) was released from the shuttle to freefly. At times during this freeflight when the PDP was magnetically connected to the shuttle, the Fast Pulsed Electron Generator (FPEG), located in the shuttle cargo bay, ejected a 1-keV - 50-mA electron beam. The plasma wave instrument on board the PDP detected intense whistler-mode radiation during these beam ejections. This paper presents a study of a whistler-mode emission detected during one particular continuous electron-beam firing. Calculations indicate that the beam radiated approximately 1.6 mW in the whistler mode as the beam transversed the 200 meters from the shuttle to the PDP. The emissivity also decreased by about a factor of 10 over this same distance. The measured wave powers are 10^7 greater than wave powers expected from incoherent Cherenkov radiation, verifying that the radiation is generated by a coherent process. Estimates of the emissivity based on measured electric-field intensities in the beam indicate that the whistler-mode noise is produced by radiation from electron bunches created by an electrostatic beam-plasma instability.

29738 **(CONF-880364—12) A two-wavelength infrared interferometer/polarimeter system for CIT [Compact Ignition Tokamak].** Ma, C.H.; Hutchinson, D.P.; Vander Sluis, K.L. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 12p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88007681/JAW.

From 7. topical conference on high temperature plasma diagnostics; Napa, CA, USA (13 Mar 1988).

The results of a fasiblity study of a two-wavelength infrared interferometerpolarimeter system for measurements of electron density and plasma current profiles in the Compact Ignition Tokamak (CIT) are presented. The system utilizes CO_2 lasers at a wavelength of 10.6 μm, and water-vapor lasers at 28 μm. Both magneto-optic and electro-optic polarization-modulation techniques have been used to determine the sensitivity and time response of the polarimetry at 10.6 μm. Measurement of a simulated plasma Faraday rotation demonstrated a sensitivity of approximately 0.01{degree} for a CO_2 laser polarimeter with an electrooptic CdTe crystal modulator. 3 refs., 4 figs.

29739 (DOE/ET/53088—316) A study of runaway electron confinement in the ASDEX tokamak. Kwon, O.J.; Diamond, P.H.; Wagner, F.; Fussmann, G. (Texas Univ., Austin (USA). Inst. for Fusion Studies; Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Mar 1988. Contract FG05-80ET53088. 38p. (IFSR—316). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88007327/JAW.

The results of runaway electron confinement experiments from ASDEX are analyzed to elucidate the structure of electromagnetic turbulence that causes anomalous electron heat transport in the L-mode confinement regime. From a simple model, the radial correlation length (W) of the magnetic turbulence is determined to be about 1 mm. Using this value and that of the experimentally deduced electron thermal diffusivity, we determine the radial magnetic fluctuation level at the plasma edge in the L-mode to be (B/sub r/B_0) {similar←to} 2 x 10^{-4}. Scalings of W and B/sub r/B_0 are deduced from parameter scans. From a comparison of these results with the predictions of various theoretical models, it is concluded that skin-depth turbulence, electromagnetic drift wave turbulence, rippling modes, and microtearing modes are inferior candidates and that resistive-ballooning modes offer the best possibility for a consistent interpretation of the data. 25 refs., 9 figs., 1 tab.

29740 (IC—87/94) Relativistic excitation of beat waves in a plasma in the presence of an external magnetic field. Salimullah, M.; Amin, M.R.; Azad, A.K.; Banerjee, A.K. (International Centre for Theoretical Physics, Trieste (Italy); Jahangirnagar Univ., Savar (Bangladesh). Dept. of Physics). (International Centre for Theoretical Physics, Trieste (Italy)). May 1987. 22p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702529/JAW.

A theoretical investigation of the nonlinear relativistic excitation of the longitudinal electron plasma wave at the beat frequency of two co-linear laser beams has been made in a hot, collisionless and homogeneous plasma in the presence of an external magnetic field. The relativistic Vlasov equation has been solved to obtain the nonlinear response of magnetized electrons. It is observed that the power conversion efficiency of the excited electron plasma wave at the difference frequency is much higher for the relativistic calculation than that for the nonrelativistic calculations. It is further noticed that the power conversion efficiency of the beat wave excitation increases slowly with the external magnetic field when the colinear laser beams propagate transverse to the direction of the external magnetic field, whereas, it is almost unaffected when the incident waves propagate parallel to the direction of the magnetic field. (author). 17 refs, 2 figs.

29741 (IPP—2/293) Numerical treatment of the transport equations in the stellarator plasma. Romatka, R.; Wobig, H. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Nov 1987. 60p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753383/JAW.

A program has been developed for calculation of the radial profiles of the ion and electron temperature and density from the transport equations, taking into account the dependence of the diffusion on the temperature gradients (thermodiffusion) and the dependence of the thermal conduction on the density gradient. The electric field can either be given or evaluated selfconsistently from the ambipolarity condition for constant particle and energy fluxes. Different models for the boundary conditions are possible. As a first application, the problem is investigated how the thermodiffusion acts on the transport processes, and if a relation to the anomalous transport exists. Such a relation has not been found. Calculations with selfconsistently determinded electric field and with vanishing electric field are compared with each other, and the effects of the ambipolar electric field on the transport processes are discussed. A simple model for modified boundary conditions is regarded.

29742 (IPP—4/234) Edge plasma heating via cyclotron harmonic interaction. Puri, S. (Association Euratom-Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.); Association Euratom-Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Dec 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753384/JAW.

Energy absorption in the edge region via cyclotron harmonic interaction during ICRF plasma heating is examined. It is shown that the electric field ripple caused by the closely spaced Faraday shield conductors gives rise to large effective perpendicular wavenumbers, resulting in strong cyclotron harmonic damping. For the parameters of the ASDEX tokamak, carbon impurity ions with Z=3 and an initial perpendicular energy of 1 eV could be accelerated to energies in excess of 100 eV in less than 10 μS (corresponding to about 100 cyclotron orbits).

29743 (IPP—III/128) VUV and ultrasoft X-ray diode detectors for tokamak plasmas. Lee, P.; Snider, R.T.; Gernhardt, J.; Armontrout, C.J. (GA Technologies, Inc., San Diego, CA (USA); Association Euratom-Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.); KMS Fusion, Inc., Ann Arbor, MI (USA)). (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.); SEE CODE- 9524084 GA Technologies, Inc., San Diego, CA (USA); Association Euratom-Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.); KMS Fusion, Inc., Ann Arbor, MI (USA)). Nov 1987. 18p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753385/JAW.

Ultrasoft X-ray diode (USXRD) arrays have been used on D-IIID and ASDEX to study plasma edge radiation, in the photon energy range from 10 eV to 10 keV. The detectors are extremely useful and versatile due to their simplicity and compactness. Furthermore, absolute quantum efficiencies (QE) of many photocathodes such as vitreous C, Al, Cu CuI, CsI and Au have been measured in recent years. With filter technique, broadband resolution, $E/\Delta E \simeq 1$, is possible. QE comparison of USXRD with semiconductor XRD is also presented to better understand the regions of applicability for each detector.

29744 (IPP—III/129) Parametric decay in the edge plasma of ASDEX during fast wave heating in the ion cyclotron frequency range. Nieuwenhove, R. van; Oost, G. van; Noterdaeme, J.M.; Brambilla, M.; Gernhardt, J.; Porkolab, M. (Ecole Royale Militaire, Brussels (Belgium). Lab. de Physique des Plasmas; Association Euratom-Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.); Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Physics; Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.); Ecole Royale Militaire, Brussels (Belgium). Lab. de Physique des Plasmas; Association Euratom-Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.); Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Physics; Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). Jan 1988. 17p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753386/JAW.

Two types of parametric decay instabilities were observed in the scrape-off layer of ASDEX during hydrogen second harmonic heating, in the single- as well as in a two-ion-species plasma. The first type was identified as decay into an ion Bernstein wave and an ion cyclotron quasimode, and the second as decay into an ion Bernstein wave and a low fequency electron quasimode. The parametric decay processes are due to the high electric fields near the fast wave antennas. Theoretical growth rate calculations predict a threshold electric field which is in reasonable agreement with the values estimated from a full-wave code, modelling the relevant experiments. These parametric decay processes, as well as the harmonics of the generator frequency also seen in the scrape-off layer, provide a mechanism that might contribute to the observed direct energy deposition in the edge plasma and to ICRF-induced impurity production.

29745 **(N—88-18427) Study of single and binary ion plasma expansion into laboratory-generated plasma wakes.** Wright, K.H. Jr. (Alabama Univ., Huntsville (USA)). Feb 1988. 186p. (NASA-CR—4125; NAS—1.26:4125). NTIS, PC A09/MF A01.

Plasma expansion into the wake of a large rectangular plate immersed in a collisionless, supersonic plasma was investigated in laboratory experiments. The experimental conditions address both single ion and binary ion plasma flows for the case of a body whose size is large in comparison with the Debye length, when the potential difference between the body and the plasma is relatively small. A new plasma source was developed to generate equi-velocity, binary ion plasma flows, which allows access to new parameter space that have previously been unavailable for laboratory studies. Specifically, the new parameters are the ionic mass ratio and the ionic component density ratio. In a series of experiments, a krypton-neon plasma is employed where the ambient density ratio of neon to krypton is varied more than an order of magnitude. The expansion in both the single ion and binary ion plasma cases is limited to early times, i.e., a few ion plasma periods, by the combination of plasma density, plasma drift speed, and vacuum chamber size, which prevented detailed comparison with self-similar theory.

29746 **(PB—88-182316/XAB) Soviet magnetic confinement fusion research. Technical assessment report.** Davidson, R.C.; Berry, L.A.; Ellis, R.A.; Hazeltine, R.D.; Hogan, J.T. (Foreign Applied Sciences Assessment Center, La Jolla, CA (USA)). Oct 1987. 247p. (FASAC-TAR—4020). NTIS, PC E09/MF A01.

See also PB—88-182124.

The report is the work of seven US scientists and engineers who surveyed and assessed Soviet research in magnetic-confinement fusion. This assessment of Soviet-fusion research concentrates on the period from 1980-81 through June 1987. The technical accomplishments during this period are reviewed, and the Soviet capabilities and outlook for future contributions are assessed. Detailed evaluations of Soviet accomplishments and capabilities are provided in areas of basic and applied plasma physics, tokamak confinement, technology and engineering, alternate confinement approaches, and fusion computations.

29747 **(PPPL-Q—44) Princeton Plasma Physics Laboratory:.** Phillips, C.A. (ed.). (Princeton Univ., NJ (USA). Plasma Physics Lab.). 1986. Contract AC02-76CH03073. 156p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88007501/JAW.

This paper discusses progress on experiments at the Princeton Plasma Physics Laboratory. The projects and areas discussed are: Principal Parameters Achieved in Experimental Devices, Tokamak Fusion Test Reactor, Princeton Large Torus, Princeton Beta Experiment, S-1 Spheromak, Current-Drive Experiment, X-ray Laser Studies, Theoretical Division, Tokamak Modeling, Spacecraft Glow Experiment, Compact Ignition Tokamak, Engineering Department, Project Planning and Safety Office, Quality Assurance and Reliability, and Administrative Operations.

29748 **(SAND—88-0426C) Intense ion beam diagnostics for particle beam fusion experiments on PBFA II.** Leeper, R.J.;Stygar, W.A.;Maenchen, J.;Ruiz, C.L.;Kensek, R.P.;Johnson, D.J.;Lockner, T.R.;Bailey, J.;Cooper, G.;Lee, J.R. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 29p. (CONF-880364—4).

From 7. topical conference on high temperature plasma diagnostics; Napa, CA, USA (13 Mar 1988).

A review of diagnostics used at Sandia National Laboratories to measure the parameters of intense proton and lithium beams generated on the PBFA-II accelerator will be presented. These diagnostics consist of several types, namely: K gamma x-ray pinhole cameras, a multi-frame dEdx ion pinhole camera, a p-i-n array ion pinhole camera, Thomson parabola spectrographs, a Rutherford magnetic spectrograph, plasma visible spectroscopy and several nuclear activation diagnostics. These components when taken together enable a rather thorough description of the 5-MW, 10-TW ion beams presently being produced. A unique feature of these diagnostics is that they are capable of operating in hard (several MeV) x-ray bremsstrahlung backgrounds of some 10^9 - 10^{10} Radsec. Details of each diagnostic, its integration, data reduction procedures, and recent PBFA-II data will be discussed. 14 refs., 12 figs.

29749 **The parallel viscous force density for stellarator transport purposes - Higher order corrections.** D'Haeseleer, W.D.; Hitchon, W.N.G.; Shohet, J.L. (Torsatron/Stellarator Lab., Univ. of Wisconsin-Madison (US)). pp 31-32 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

The final goal of this research is the self-consistent computation of interesting "observables" such as transport fluxes, parallel flows, Pfirsch-Schluter and bootstrap currents and the ambipolar electric field, in the low collision frequency regimes in stellarators. The authors attack the problem numerically and utilize ideas employed in a bounce-averaged transport study, and concepts based on moment formalism. The moment approach points out the importance of the "parallel viscous force density" $<B \cdot del \cdot \pi>$ in that it is the quantity that gives use to the bootstrap current and the so-called "axisymmetric flux." In order to find $<B \cdot del \cdot \pi>$, two important requirements must be satisfied: the collision operator must be momentum conserving and the distribution function must be allowed to vary along a field line.

29750 **Olive - A small, low-aspect ratio tokamak.** Crowley, T.P. (Rensselaer Polytechnic Institute, Troy, NY 12180-3590 (US)). pp 30-31 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

The design study of a low aspect ratio tokamak is presented. The device uses the existing facilities at the RPI Plasma Dynamics Laboratory as much as possible. The plasma parameters that can be achieved, the coil structure, and energy storage requirements are presented. A low aspect ratio tokamak can achieve large values of IaB due to toroidal effects and natural plasma shaping, where I is the plasma current, a is the minor radius and B is the toroidal field. Olive is predicted to obtain IaB — 4.5 kAcm kG. The ohmic heating from this current produces a relatively high temperature in a small device. The authors calculated the plasma temperature by assuming neo-Alcator heat loss and the density by assuming n/sub e/ RB/sub T/ = 10^{11} cm $^{-3}$ (cgs units used). If R = 25 cm, a = 15 cm, B/sub T/ = 1.5 kG, and κ = 2, a plasma with T/sub e/ = 300 eV, I/sub p/ = 100 kA, n/sub e/ = 6 x 10^{12} and B = 2% can be achieved, where κ is the elongation.

29751 **Electromagnetic compression gun for hypervelocity projectile acceleration.** Woo, J.T. (InterScience, Inc., Troy, NY 12180 (US)). pp 110 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

The rapid acceleration of projectiles to very high velocities has applications in many areas. The general requirements for an effective system is simplicity, reliability, compactness and good efficiency. The authors developed a concept by using electromagnetic forces to compressionally heat a plasma to high temperature and pressure to serve as the propellant for the acceleration of projectiles. The concept shares the simplicity of the light gas gun, but because of the high temperature of the propellant, is capable of significantly higher performance. Unlike the electrothermal gun approach to raise the propellant temperature by resistive heating, the electromagnetic concept is more efficient at higher temperatures. Operationally, the concept resembles a railgun in requiring a large pulsed current to drive the system. However, the current flow in this case is entirely external to the gun barrel and is axisymmetric. Therefore, many of the problems associated with railgun operations are avoided. Furthermore, because the current channel is external, there is also greater flexibility in the choice of load impedance to match to the power supply. The concept can also be generalized to a multi-stage regenerative system driven by a pulse forming network to resemble a coaxial accelerator.

29752 A variational analysis of a cross field amplifier. Pitale, L.A. (Villanova Univ. (US)). pp 36-37 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

This work describes a theoretical analysis of a cross-field amplifier. First, a multi-mode analysis of an empty two dimensional RF slow wave structure is shown. Next, both an applied voltage between the anode and cathode and an external static magnetic field are included. Then a non-neutral electron plasma layer is added near the cathode. The plasma is first modeled with equivalent currents, including relativistic effects, then with a cold-fluid model. All of the above fields and the electron plasma are included in a variational method derived for this structure. The results of this analysis show device frequency shifts associated with the presence of the plasma and plasma reshaping due to plasma/field interactions.

29753 Two-dimensional simulations of a plasma streaming across a magnetic field. Galvez, M.; Barnes, C. (Los Alamos National Lab., Los Alamos, NM 87545 (US)). pp 38 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

A two dimensional electrostatic particle simulation code has been used to study a plasma streaming across a uniform magnetic field in vacuum. For all densities studied, polarization charge layers are formed. For plasmas densities, n, greater than a critical density, n/sub c/, the electron charge layer becomes unstable. The growth time of the instability is shorter for dense plasmas and the ion plasma near to the electron charge layer also becomes unstable. This instability has been identified as the diocotron instability.

29754 Real space diffusion in drift wave turbulence. Robinson, E.; Ishihara, O. (Dept. of Electrical Engineering, Texas Tech Univ., Lubbock, TX 79409 (US)). pp 36 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

In drift wave turbulence characterized by a sheared magnetic field B-vector = B_0(e-vector/sub z/ + chiL/sub s/e-vector/sub y/), where L/sub s/ is the shear length, and random electrostatic fields, PHI(chi,t) = Σ/sub mn/PHI/sub mn/ x e/sup i(k//sub m/y + k/sub n/z - ϵ/sub mn/t), where PHI/sub mn/ is the electric potential of the (m,n) mode, a numerical experiment has been carried out to examine the particle diffusion process in real space. Two cases are examined, one with an infinite number of n-modes and the other with a single n-mode. 100 m-modes are used for both cases. For infinite n-modes, diffusion coefficients found are in agreement with the value D = π Σ/sub m/ <(absolute value of m PHI/sub m/)^2> as was predicted for a low turbulence level, while for a single n-mode we observe that diffusion greatly depends on the choice of m and n.

29755 Reflection from a suddenly created lossy plasma half-space. Kalluri, D. (Dept. of Electrical Engineering, Univ. of Lowell, Lowell, MA 01854 (US)). pp 34-35 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

In a previous paper, the transient reflection from a lossless suddenly created plasma half-space is discussed. The reflected wave has two components. The A component is due to reflection off the space boundary. The B component is of a new frequency than the incident wave frequency and is due to temporal discontinuity. The limiting value of the B component is zero even if the plasma is only slightly lossy. This paper discusses the transient solution for the reflected wave taking into account the damping of the waves in a lossy plasma.

29756 Experimental investigation of hemispherical ion acoustic solitons in a double plasma device. Zaidman, E.G.; Oleson, N.L. (Naval Research Lab., Code 6840, Washington, DC 20375 (US)). pp 35 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

During the past decade a number of papers have appeared on both the theoretical and experimental aspects of spherical ion acoustics solitons in plasmas. This paper is concerned with their experimental observed properties in a double plasma device containing argon at 2.5 x 10^{-4} torr. The separating grid is hemispherical in shape, the center of curvature being on the test side. A positive voltage pulse applied to this separating screen causes hemispherical ion acoustic solitons to be generated in the test plasma, free of reflected waves. The resulting solitons have different properties than those produced in a spherical arrangement.

29757 Bilinear-control formulation of plasma boundary-value problems. Kalluri, D.; Goteti, V.R. (Dept. of Electrical Engineering, Univ. of Lowell, Lowell, MA 01854 (US)). pp 35 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

Several situations may be successfully approximated as bilinear control problems, in the sense the system is linear with respect to the state variables and with respect to control variables individually but not linear with regard to both the state and the control variables. This paper explores the application of bilinear system theory to the problems of electromagnetic wave interactions with a bounded plasma medium. A specific example of oblique incidence of a parallel polarized wave on a uniaxial, temperate, lossy plasma slab is considered. The particle density profile is controlled to achieve maximum absorption. Choice of tangential electric and magnetic fields, the normal component of particle velocity and pressure as the state variables leads to the state-variable formulation of plasma boundary-value problems.

29758 Theoretical and computational aspects of the magnetic confinement of particles and plasmas. Mehanian, C. Ithaca, NY; Cornell Univ. (1987). 228p. University Microfilms Order No. 87-08,884.

Thesis (Ph. D.).

This thesis covers various aspects of the magnetic confinement of particles and plasmas. In the first problem, the setting is a device that is a candidate for a fusion reactor and thus represents a collection of ionized atoms at a very high temperature. The second problem concerns the magnetic confinement of a neutral-hydrogen gas at a temperature low enough that a Bose-Einstein condensation occurs. The tilt stabilization of a spheromak by an energetic-particle ring is analyzed. A comprehensive survey is made of numerically generated, hybrid equilibria which describe spheromak plasmas with an energetic ion-ring component. Unlike the analytic treatments, neither the ion-ring toroidal current nor the inverse aspect ratio are required to be small. The tilt stability of the plasma is determined by calculating the torque due to the magnetic interaction with the ion ring, assumed fixed. The confinement of an atomic hydrogen gas in the trap formed by a time-varying magnetic field is investigated. The trap uses the interaction of the magnetic field with the magnetic moments of the atoms, which are kept aligned by a strong uniform field. The effect of collisions is included via a Monte Carlo algorithm and it is found that the atoms can be confined when the frequency and the current of the coils producing the time-varying field are appropriately chosen.

29759 Stability of an axisymmetric mirror with an energetic-ion component. Krall, J.F. Ithaca, NY; Cornell Univ. (1987). 174p. University Microfilms Order No. 87-08,946.

Thesis (Ph. D.).

The stability of an axisymmetric mirror with an energetic-ion component to finite azimuthal mode number (m) interchange modes is examined, using a dispersion functional in which the energetic ions are described by the Vlasov equation and the background

plasma is described by the magnetohydrodynamic (MHD) equations. A separate analysis is presented for the Vlasov-fluid case [Freidberg, 1972], where the background consists of fluid electrons. Stability is addressed first for an elongated equilibrium with a specific class of energetic ion orbits in the Vlasov-MHD case and then for both cases with more general equilibria and orbits. With the elongated mirror, the axis-encircling ions are assumed to have orbits that reside on flux surfaces, obtaining a sufficient conditions for stability on each flux surface. Numerical evaluation of the stability condition indicates that the energetic-ion component is highly stabilizing in regions where the energetic ion density increases outward and highly destabilizing where the density decreases outward. The more general problem is considered by representing the displacement in terms of a complete set of global basis functions. It was found that in the Vlasov-MHD case, where a rigid-rotor distribution is used for the energetic ions, the net rotation of the energetic ions is destabilizing and dominates the stabilizing influence of the energetic ion current.

29760 **Electrical and spectroscopic characterization of a theta-pinch magnetically confined exploding-conductor analytical plasma.** Johnson, E.T. Ann Arbor, MI; Univ. of Michigan (1987). 235p. University Microfilms Order No. 87-12,140.

Thesis (Ph. D.).

The studies reported here have shown that the exploding-graphite fiber-bundle plasma system is well suited for the direct trace elemental analysis of samples in both solution and particulate form. The analytical utility of the exploding-graphite fiber-bundle plasmas was demonstrated under a variety of conditions. Linear analytical curves were obtained for several elements. Detection limits in the range of 5-20 ng were obtained for Cr and Mn under a variety of discharge conditions. Detection limits in the low-microgram range were obtained for Pb. The cylindrical geometry of the graphite-fiber-bundle plasma makes it amenable to magnetic-field confinement using the theta-pinch configuration. Benefits arising from the use of the magnetic field in conjunction with the plasma include better line-radiation reproducibility, reduced particle-size effects, lower-continuum radiation intensity, and greater linearity for analytical curves. The effect of the magnetic field on the plasma was enhanced by the unidirectional capacitive-discharge system. Time-resolved photoelectric measurements show a reduction in continuum radiation of over 50% relative to an equivalent oscillatory discharge; neutral and ion line-radiation intensities were relatively unchanged. The unidirectional discharge system also demonstrated more-efficient spatial confinement of continuum radiation intensity.

29761 **Relaxation and particle diffusion in the Proto S-1/C spheromak.** Meyerhofer, D.D. Princeton, NJ; Princeton Univ. (1987). 154p. University Microfilms Order No. 87-05,912.

Thesis (Ph. D.).

The relationship between relaxation and particle diffusion in the Proto S-1C spheromak has been studied. The plasma was formed in a magnetic configuration which was not the minimum-energy Taylor state, and went through a period of relaxation before its magnetic configuration was that of the Taylor state. Early in the relaxation phase, the internal and external magnetic fluctuations were correlated and it was found that, at the time of peak amplitude, they had a radial structure of a tearing mode. After the reconnection of these modes, the plasma continued to evolve towards the Taylor state with only small magnetic fluctuations at the center of plasma. The local particle diffusion coefficient was measured in these Proto S-1C discharges, the technique used was to inject a delta-function source of impurities into the plasma and observe the motion of the impurities relative to the flux surface. It was found that, during the decay phase of the spheromak discharge, when the plasma was in a Taylor state, the carbon diffusion coefficient was explained classically. While the plasma was relaxing towards the Taylor state, the diffusion coefficient was 2 $\sim$ 4n times larger than classical. At this time, the plasma was not yet force-free. This non-classical diffusion appears to have been caused by v/sub ExB/ velocities due to correlations between the fluctuating electric field and density. Because the v/sub ExB/ velocity acts on all of the plasma species similarly, the anomalous hydrogen-particle diffusion coefficient should have been as large as that of carbon.

29762 **Mirror-ratio scaling of the axial plasma loss in collisional and collisionless regimes.** Lam, K.L. Los Angeles, CA; Univ. of California (1986). 104p. University Microfilms Order No. 87-02,601.

Thesis (Ph. D.).

The axial losses of strongly collisional ions and electrons of different degrees of collisionality are studied. The axial confinement time of a single-cell mirror is found to be proportional to the mirror ratio over the range of 12-74 when the ions are strongly collisional, i.e., the mean free path for Coulomb collisions is less than the length of the device. The reduction in total axial-loss current is shown to correspond to the reduction of the cross-sectional area of the plasma at the magnetic mirror as the mirror ratio is increased. The axial-loss current density is independent of the mirror ratio and is proportional to the product of plasma density and the acoustic speed. The axial-loss current density of collisional electrons is also independent of the mirror ratio. For collisionless electrons the axial-loss current density increases with the mirror ratio. This current density is proportional to density squared and, for low RF heating power, to T/sub e/$^{-3}$2, in good agreement with collisionless theory. Axial-loss current scaling deviates strongly from collisionless theory for a period immediately following the RF heating pulse. This period is longer for higher heating power.

29763 **Microwave heating of electrons in an end plug of the Phaedrus tandem mirror.** Sing, D.C. Madison, WI; Univ. of Wisconsin (1986). 214p. University Microfilms Order No. 87-28,694.

Thesis (Ph. D.).

Experiments were undertaken to investigate the heating of electrons in the tandem mirror Phaedrus by application of a microwave RF pulse into a single end plug (density n/sub p/ $\sim$ 3.5 x 10^{12} cm^{-3}, ion energy E/sub i/ $\sim$ 700 eV, and electron temperature T/sub e/ $\sim$ 18 eV) of the tandem-mirror plasma. A 1-ms, 25-kW, 15.5-GHz microwave pulse resonant with the second harmonic of the electron cyclotron frequency (w = 2w/sub ce/) was injected into one end plug (east plug) of the tandem mirror. The combined electron and ion energy increased up to 400 eV in the east plug and 140 eV in the west plug. Thomson-scattering electron-temperature measurements and neutral energy analyzer measurements showed that the most of the plug plasma energy increases were due to increases in ion energy. An ion-energy-rate equation model was used to show that the ion energy increases were due to a reduction in the electron drag losses on the ions. Hot electrons (T/sub e,hot/ $\leq$ 6 keV) were detected in the east plug by x-ray and cyclotron-emission diagnostics. Measurements of the line density in the plugs and local density by central cell probes showed that the plasma column shifted off-axis a distance comparable to the plasma radius ($\sim$ 12 cm) as a result of the application of the microwave RF pulse. The shift was in the direction towards the microwave antenna and the ICRF antennas.

29764 **Study of nonlinear dynamical models of plasma turbulence.** Qian, S. College Park, MD; Univ. of Maryland (1986). 191p. University Microfilms Order No. 87-09,451.

Thesis (Ph. D.).

An exact nonlinear mode truncation method, i.e., the pole expansion method, is developed to study one-dimensional models of plasma turbulence. The internal wave is magnetized plasma in which the magnetic field changes sharply over a small region obeys the modified Benjamin-Ono equation. This equation with periodic boundary conditions can be solved by a pole-expansion technique, which changes the dissipative Benjamin-Ono equation to a system of ordinary equations of poles. The pole expansion is an exact nonlinear mode-truncation method in which a finite number of poles are used to represente the asymptotic behavior of the system. Numerical results and analytical proof show that the pole representation is complete. The equation of poles allows linear and nonlinear stability analyses. Because the number of poles in the asymptotic state is proportional to the ratio of the growth to the damping, fully developed turbulence can be reached if the system has a very large number of poles. Additional research was performed to study the statistical properties of turbulent flows, including correlation functions and energy spectra.

29765 **Turbulent dynamo theory and its possible applications to reversed-field pinches.** Chen, H. Hanover, NH; Dartmouth College (1986). 139p. University Microfilms Order No. 87-28,282.

Thesis (Ph. D.).

Turbulent transport effects due to small-scale fluctuation in large-scale structures in MHD systems are very important both in space-plasma situations and fusion-plasma situation. However, the original turbulent alpha dynamo theory is insufficient when applied to the latter. In this thesis, a generalization of the alpha dynamo theory is attempted. First completed are some multiple-scale perturbation calculations of turbulent MHD transport coefficients begun in earlier papers. These generalize the original dynamo-effect coefficient calculations by treating the velocity field and magnetic fields on the same footing. Then, the problem of rendering such calculations self-consistent is addressed, generalizing an eddy-viscosity hypothesis similar to that of Heisenberg for the Navier-Stokes case. The method also borrows from Kraichnan's direct-interaction approximation. The output is a set of integral equations relating the spectra and the turbulent-transport coefficients. Previous alpha effect and beta effect coefficients emerge as limiting cases. The new approach thus underpins, to an extent, the turbulent dynamo theory as applied to toroidal flux generation in reversed-field pinch-effect experiments. A treatment of the inertial range using the new method can also be given, consistent with a -5/3 energy spectrum power law. In the Navier-Stokes limit, a value of 1.72 is extracted for the Kolmogorov constant. Further applications to MHD are possible.

29766 **Scattering of electromagnetic radiation by dense plasmas.** Khiari, C.E. Ann Arbor, MI; Univ. of Michigan (1986). 139p. University Microfilms Order No. 87-02,760.

Thesis (Ph. D.).

In most previous theoretical investigations, the effect of binary collisions between particles, in a fully-ionized plasma, on the shape of the scattered radiation spectrum, was neglected. The common result of these investigations was that, for low-density plasmas, interparticle collisions are negligible and, therefore, a Vlasov description is valid. In the Vlasov description, Landau damping is the only damping mechanism included. While this approach is valid for low-density plasmas in which collisions between particles are negligible, it is not applicable to high-density, low-temperature an, hence, collision-dominated plasmas, as many investigations showed. One such investigation used a BGK approach to modeling collisions between particles in a fully ionized plasma, but it failed to incorporate collisions between unlike-charged particles. In this work, it is shown, using a BGK model for collisions between like-charged and unlike-charged particles, along with a stochastic approach for the calculation of the scattering function, that for a high-density, low-temperature plasma ($N \geqq 10^{19} cm^{-3}$), collisions between electrons and ions are important and, therefore, cannot be neglected. The model used allows for an analytic solution from which numerical results are readily obtained.

29767 **Trapping of a gun-injected plasma by a tokamak.** Leonard, A.W. Madison, WI; Univ. of Wisconsin (1986). 200p. University Microfilms Order No. 86-28,674.

Thesis (Ph. D.).

A Marshall gun was used to refuel a tokamak discharge on the Tokapole II device. Gun injection was able to increase the line-averaged density of the discharge by 50%. The density profile became more peaked due to gun injection. A model is discussed that describes the trapping of a gun-injected plasma in a pure octupole field due to a depolarization current. This model is expanded to include arbitrary toroidal fields added to the poloidal field. A slowing time tau/sub s/, is derived for the trapping of an injected plasma of density n/sub b/, and temperature, T/sub e, into poloidal field, B//sub p/ and toroidal field, B/sub t/. Experimental observation of plasma injected into an octupole filed fits the derived slowing relation, with an exception in the beam density dependence. An anomalous resistivity at low field strengths could account for the conflict, though the nature of this resistivity is not understood. The more tokamak-like case of injection into poloidal and toroidal fields fits the data. The experiment is extended to the tokamak discharge by the addition of plasma density and current to the vacuum fields. Plasma density is seen to not significantly affect trapping. An extrapolation is made of the refueling system to the reactor-size tokamak TFTR. An effective system seems easily obtainable.

29768 **EM radiation from strong Langmuir turbulence.** Akimoto, K. College Park, MD; Univ. of Maryland (1986). 268p. University Microfilms Order No. 87-02,142.

Thesis (Ph. D.).

EM radiation by strong Langmuir turbulence is investigated by means of theory and simulation, with emphasis on the latter. For this purpose a fully nonlinear 2-1/2-D EM two fluid code, which can carry out simulations of extremely strong Langmuir turbulence, was developed. The results are presented of the first self-consistent simulations of the EM radiation from strong Langmuir turbulence (collapsing Langmuir solitons). A series of initial-value runs revealed that Langmuir pump waves evolve into solitons enhancing the EM radiation by many orders of magnitude. The radiation level is considerably higher than that of weak Langmuir turbulence. The simulation results are in reasonable agreement with an extended theoretical model of EM radiation by collapsing Langmuir solitons. Some scaling properties of the EM radiation were also investigated by means of theory and simulation. In addition, several other important properties (both ES and EM) were also found and analyzed. This work also includes derivation of a generalized nonlinear dispersion relation for parametric instabilities of ES or EM plasma waves; utilizing it, some novel parametric instabilities of Langmuir waves that directly generate EM plasma waves are found.

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REFER ALSO TO CITATION(S) 29336, 29701, 29748

29769 **(ANL/FPP/TM—217) The requirements for processing tritium recovered from liquid lithium blankets: The blanket interface.** Clemmer, R.G.; Finn, P.A.; Greenwood, L.R.; Grimm, T.L.; Sze, D.K.; Bartlit, J.R.; Anderson, J.L.; Yoshida, H.; Naruse. (Argonne National Lab., IL (USA); Los Alamos National Lab., NM (USA); Japan Atomic Energy Research Inst., Tokai, Ibaraki). Mar 1988. Contract W-31109-ENG-38. 62p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88007346/JAW.

We have initiated a study to define a blanket processing mockup for Tritium Systems Test Assembly. Initial evaluation of the requirements of the blanket processing system have been started. The first step of the work is to define the condition of the gaseous tritium stream from the blanket tritium recovery system. This report summarizes this part of the work for one particular blanket concept, i.e., a self-cooled lithium blanket. The total gas throughput, the hydrogen to tritium ratio, the corrosive chemicals, and the radionuclides are defined. The key discoveries are: the throughput of the blanket gas stream (including the helium carrier gas) is about two orders of magnitude higher than the plasma exhaust stream;the protium to tritium ratio is about 1, the deuterium to tritium ratio is about 0.003;the corrosion chemicals are dominated by halides;the radionuclides are dominated by C-14, P-32, and S-35;their is high level of nitrogen contamination in the blanket stream. 77 refs., 6 figs., 13 tabs.

29770 **(CONF-871272—1-Vugraphs) TSC disruption-induced forces on the CIT 1.75 m vacuum vessel and internal coils.** Sayer, R.O.;Jardin, S.C.;Strickler, D.J. (Princeton Univ., NJ (USA). Plasma Physics Lab.). 1987. Contract AC05-84OR21400. 18p.

From CIT PF design workshop; Princeton, NJ, USA (1 Dec 1987).

This paper discusses a critical CIT design issue: vacuum vessel (VV) safety margin relative to loads arising from VV eddy currents induced by plasma motion and current decay during disruptions. The motivation if this study is needed to perform disruption simulations which would provide time histories of the VV currents required for detailed engineering load and stress analyses. Calculation of the time evolution of forces on the VV and on the internal coils and the analysis of the effects of plasma current decay rate, initial beta value, and plasma trajectories are discussed. Also discussed is simulation model, VV results and internal coil results. 8 figs., 2 tabs.

29771 (DOE/ER/75172—5, pp 97-99) **Laser driven inertial confinement fusion.** Derks, W. (Arizona State Univ., Tempe (USA)). 1987. NTIS, PC A06/MF A01. Order Number DE88005041/JAW. (CONF-8703231—Summs.).

From Western region American Nuclear Society student conference: nuclear technology for the year 2000; Albuquerque, NM, USA (19 Mar 1987).

This paper is a 2000 word technique research report on the mechanics, design requirements, and recent developments of the three major components used in laser driven inertial confinement fusion reactors. These components are the laser, the fuel pellet, and the blast chamber. The objective of this report is to provide a general feasibility study on this specific approach to fusion power production. A general overview of the basic operations; nuclear physics, fuel pellet fabrication, pellet injection, fuel pellet density, laser power requirements and pulse length, different reactor cavity designs, and blast chamber protection with lithium blanket. This report is mostly informative and expresses the viability of laser fusion.

29772 (DOE/ER/75172—5, pp 100-104) **FIREBIRD - a conceptual design of a field reversed configuration compact torus fusion reactor (CTFR).** Raman, R.; Zubrin, R.M. (Univ. of Washington, Seattle (USA)). 1987. NTIS, PC A06/MF A01. Order Number DE88005041/JAW. (CONF-8703231—Summs.).

From Western region American Nuclear Society student conference: nuclear technology for the year 2000; Albuquerque, NM, USA (19 Mar 1987).

This paper is a summary of the work carried out by the Nuclear Engineering 512 design team at the University of Washington on a conceptual design study of a Compact-Torus (Field-Reversed) Fusion Reactor Configuration (CTFR). The primary objective of the study was to develop a reactor design that strived for high engineering power density, modest recirculating power and competitive cost of electrical power. A Conceptual design was developed for a translating field-reversed configuration reactor; based on the Physics developed by Tuszewski and Lindford at LANL and by Hoffman and Milroy at MSNW. Furthermore, it also appears possible to operate a simplified form of this reactor using a pure D-D fuel cycle after an initial D-T ignition ramp to reach the advanced fuel operating regime. One optimistic reactor so designed has a length of about 35 meters, producing a net electrical power of about 375 MWe.

29773 (DOE/ER/75172—5, pp 105-107) **Tesla's coherent plasma discharge -and- a plan for megavolts at Megahertz.** Nichson, J.D. (Univ. of New Mexico, Albuquerque (USA)). 1987. NTIS, PC A06/MF A01. Order Number DE88005041/JAW. (CONF-8703231—Summs.).

From Western region American Nuclear Society student conference: nuclear technology for the year 2000; Albuquerque, NM, USA (19 Mar 1987).

In his lecture on Experiments With Alternate Currents of High Potential and High Frequency before the Institute of Electrical Engineers in London (1892), Tesla reports a discharge through a partially evacuated air tube of 1 meter length and 1 inch diameter. It is characterized by the following properties: (1) The filamentary discharge may be locally displaced by a nearby dielectric body or a magnet. (2) When the filament is released, it demonstrates behaviour similar to that of a string which suspends a weight, including the formation of standing waves with distinct nodes. (3) Its decay time is on the order of 8 minutes. (4) The vibrating filament may be split with a magnet to produce two vibrating filaments. (5) This effect could only be formed with a dynamo-driven coil at low air pressures in the tube. The disruptive discharge coil (coloquially a Tesla Coil) failed to produce the effect with its superior voltage and frequency range. It is here proposed that this phenomenon is related to positive leader formation. A model for this, consistent for AC and DC discharges, is advanced. Also, a novel method for regulation of a nitrogen-filled spark gap will be proposed. It is hoped that this new device will produce smooth, uniform discharges from the Tesla Coil. This, if theory is correct on many points, will reproduce Tesla's coherent plasma at higher pressures in free-standing form, and will allow other novel effects.

29774 **(FEDC-R—87-INTOR-1) Systems analysis of INTOR-like designs.** Flanagan, C.A.; Galambos, J.D. (Oak Ridge National Lab., TN (USA)). Nov 1987. Contract AC05-84OR21400. 72p. (CONF-8707106—5-Draft). NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88004422/JAW.

From International tokamak reactor workshop; Vienna, Austria (13 Jul 1987).

A systems analysis of the five INTOR-like designs was performed. This study was established to evaluate and determine the specific impact produced in a given deisgn by making a specific change in that design. Such a quantitative analysis of the impact of various changes can provide evaluable insights as to how different choices affect a given design. The results of this analytic comparative study of the five INTOR-like designs should allow the fusion community to factor such design impacts into the development of the next generation of tokamak designs.

29775 **(INIS-BR—1056) Wall conditioning of the TBR-1 Tokamak by plasma generated by microwaves.** Elizondo, J.I. (Sao Paulo Univ. (Brazil). Inst. de Fisica). 1986. 196p. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88702603/JAW.

A new system of vaccum chamber wall conditioning in the TBR-1 Tokamak, using electron cyclotron resonance plasma of hydrogen for the discharge cleaning process is presented. The construction and performance of equipments are described, and the cleaning process to otimize the conditioning efficiency by chase of plasma parameters.

29776 **(Juel—2145) Particle collector scoops for improved exhaust in 'axisymmetric' devices.** Conn, R.W.; Wolf, G.H. (California Univ., Los Angeles (USA)). (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Plasmaphysik; California Univ., Los Angeles (USA)). Jul 1987. 18p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753387/JAW.

Application of particle collector scoops in front of the pumping ducts of axisymmetric divertor/magnetic limiter configurations is proposed. These scoops should enclose a significant fraction of the recycling particles. The resulting increase in neutral particle pressure in front of the pumping ducts leads to an improved exhaust efficiency. This can permit an extension of the operational margin for density control. Alternatively, aiming at a prescribed exhaust flow in reactor-type devices such as INTOR, the pumping ducts could be reduced in aperture, leaving valuable space for other components. The lay-out of the proposed scheme depends on the heat load on the leading edge in front of the scoop and on the deflector plate in front of the pumping ducts.

29777 **(LA-UR—88-409) Aurora status and plans.** Kristal, R.; Blair, L.S.; Burrows, M.D.; Cartwright, D.C.; Goldstone, P.D.; Greene, D.P.; Hanlon, J.A.; Hauer, A.; Kang, M.; Kortegaard, B.L. (Los Alamos National Lab., NM (USA)). Oct 1987. Contract W-7405-ENG-36. 27p. (CONF-871093—5). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006476/JAW.

From 8. international workshop on laser interaction and related plasma phenomena; Monterey, CA, USA (27 Oct 1987).

Aurora is a short wavelength (248 nm) 10 to kJ KrF laser systems in the ICF program at Los Alamos National Laboratory. It is both an experiment in driver technology and a means for studying target performance using KrF laser light. Both features will be used to help evaluate the uv excimer laser as a viable fusion driver. The system has been designed to employ several electron-beam pumped amplifiers in series, with a final aperture of one meter square, to amplify 96 angularly mulitplexed 5 ns beamlets to the 10 kJ level. In Phase I, 48 of these beamlets are brought to target by demultiplexing and focusing with f26 optics. The beamlet ensemble, contained within an f1.9 bundle, is focused as a single beam;however, pointing is done individually. Spot size in the target plane is variable from 0.1-4 mm, with maximum averaged intensity of {similar←to} 4×10^{15} Wcm^2. The illumination geometry is designed specifically for several classes of important target physics experiments. These include: energy flow, symmetry and preheat stud-

ies related to indirectly driven targets;x-ray conversion and plasma coupling characterization on disc targets, and hydrodynamic instability studies in planar geometry. System integration is proceeding toward initial target experiments in {similar←to} late 1988. Ninety-six beam amplification through the penultimate amplifier has been obtained at the sub-kJ level. Installation of beam train optics is proceeding, and the target system vacuum envelope is in place. 18 refs., 12 figs., 2 tabs.

29778 **(LA-UR—88-444) The safety record at the tritium systems test assembly.** Coffin, D.O. (Los Alamos National Lab., NM (USA)). Feb 1988. Contract W-7405-ENG-36. 18p. (CONF-880505—2). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88006466/JAW.

From 3. topical meeting on tritium technology in fission, fusion and isotopic applications; Toronto, Canada (1 May 1988).

This work addresses an important objective of the TSTA-demonstrating that the large tritium inventories required for fusion reactors can be routinely handled, without radiation exposure to operating personnel and without significant environemtnal releases. The techniques by which TSTA has achieved low releases and personnel exposures include high-integrity primary piping systems that exclude contact between tritium and organic materials, a secondary containment system that encloses all primary tritium piping in a controlled environment, an efficient, all-purpose tritium waste-treatment plant with 100% availability, and ultrasensitive, real-time diagnostics for anticipating and preventing releases, and for detection and location of tritium leaks in a low-risk mode. 5 refs., 11 figs., 2 tabs.

29779 **(LA-UR—88-872) Single column and two-column H-D-T distillation experiments at TSTA.** Yamanishi, T.; Yoshida, H.; Hirata, S.; Naito, T.; Naruse, Y.; Sherman, R.H.; Bartlit, J.R.; Anderson, J.L. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment; Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 22p. (CONF-880505—4). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88007838/JAW.

From 3. topical meeting on tritium technology in fission, fusion and isotopic applications; Toronto, Canada (1 May 1988).

Cryogenic distillation experiments were peformed at TSTA with H-D-T system by using a single column and a two-column cascade. In the single column experiment, fundamental engineering data such as the liquid holdup and the HETP were measured under a variety of operational condtions. The liquid holdup in the packed section was about 10 {approximately} 15% of its superficial volume. The HETP values were from 4 to 6 cm, and increased slightly with the vapor velocity. The reflux ratio had no effect on the HETP. For the wo-column experiemnt, dynamic behavior of the cascade was observed. 8 refs., 7 figs., 2 tabs.

29780 **(LA-UR—88-873) Experience of TSTA [Tritium Systems Test Assembly] milestone runs with 100 grams-level of tritium.** Anderson, J.L.; Bartlit, J.R.; Varlson, R.V.; Coffin, D.O.; Damiano, F.A.; Sherman, R.H.; Willms, R.S.; Yoshida, H.; Yamanishi, T.; Naito, T.; Hirata, S.; Naruse, Y. (Los Alamos National Lab., NM (USA); Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). 1988. Contract W-7405-ENG-36. 12p. (CONF-880505—10). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88007837/JAW.

From 3. topical meeting on tritium technology in fission, fusion and isotopic applications; Toronto, Canada (1 May 1988).

The first loop operation tests of the Tritium Systems Test Assembly (TSTA) with 100 grams-level of tritium were performed at the Los Alamos National Laboratory (LANL) in June and July, 1987. The July run was resumption of the June run, which was halted because of a loss of cryogenic refrigerant in the hydrogen isotope separation system. 3 refs., 3 figs.

29781 **(LA-UR—88-876) Fusion tritium program in the United States.** Anderson, J.L.; Bartlit, J.R. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 9p. (CONF-880505—5). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88007836/JAW.

From 3. topical meeting on tritium technology in fission, fusion and isotopic applications; Toronto, Canada (1 May 1988).

The fusion technology development program for tritium in the US is centered around the Tritium Systems Test Assembly (TSTA) at Los Alamos National Labortory. Objectives of this project are to develop and demonstrate the fuel cycle for processing the reactor exhaust gas (unburned deuterium and tritium plus impurities), and the necessary personnel and environemntal protection systems for the next generation of fusion devices. The TSTA is a ful'-scale system for an INTOR/ITER sized machine. That is, TSTA has the capacity to process tritium in a closed loop mode at the rate of 1 kg per day, requiring a tritium inventory of about 100 g. The TSTA program also interacts with all other tritium-related fusion technology programs in the US and all major programs abroad. This report is a summary of the results and interactions of the TSTA program since a previous summary was published and an overview of related tritium programs.

29782 **(LA-UR—88-877) Operating experience and procedures at the tritium systems test assembly.** Carlson, R.V.; Binning, K.E.; Cole, S.P.; Jenkins, E.M.; Wilhelm, R.C.; Cole, S.P. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 9p. (CONF-880505—6). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88007835/JAW.

From 3. topical meeting on tritium technology in fission, fusion and isotopic applications; Toronto, Canada (1 May 1988).

Operating procedures are important for the safe and efficient operation of the Tritium Systems Test Assembly (TSTA). TSTA has been operating for four years with tritium in a safe and efficient manner. The inventory of tritium in the process loop is 100 grams and several milestone runs have been completed. This paper describes the methods used to operate TSTA. 3 refs., 1 fig.

29783 **(PNL-SA—15177) Irradiation effects on tungsten stabilized martensitic steels.** Gelles, D.S.; Hsu, C.Y.; Lechtenberg, T.A. (Pacific Northwest Lab., Richland, WA (USA); General Atomics Co., San Diego, CA (USA)). Aug 1987. Contract AC06-76RL01830. 15p. (CONF-871036—34). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88007074/JAW.

From 3. international conference on fusion reactor materials; Karlsruhe, F.R. Germany (4 Oct 1987).

Tungsten stabilized martensitic stainless steels are being developed for fusion reactor first wall application in order to lower retained radioactivity so as to permit shallow land burial after reactor decommissioning. Two such alloys have been designed, fabricated, fast neutron irradiation in FFTF and examined by transmission electron microscopy. The two compositions were Fe-7.5Cr-2.OW-.17C and Fe-10.2Cr-1.7W-.3V-.-2C. Conditions examined included irradiation temperatures of 365, 420, 520 and 600 C to doses as high as 34 dpa. Small amounts of void swelling are found at the two lowest temperatures. It is demonstrated that levels of tungsten on the order of 2 wt% do not result in excessive intermetallic precipitation under these irradiation conditions. 11 refs., 8 figs., 4 tabs.

29784 **(SAND—87-3136C) A multi-frame ion pinhole camera for intense ion beam transport and focusing experiments.** Stygar, W.A.; Leeper, R.J.; Mix, L.P.; Brock, E.R.; Bailey, J.E.; Hebron, D.E.; Johnson, D.J.; Lockner, T.R.; Maenchen, J.; Mehlhorn, T.A. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 16p. (CONF-880364—5). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88007283/JAW.

From 7. topical conference on high temperature plasma diagnostics; Napa, CA, USA (13 Mar 1988).

We have developed a new ion pinhole camera to obtain energy density profiles of a focused multi-terawatt ion beam as a function of ion energy. Beam ions that are elastically scattered from a thin gold foil are imaged through six baffled pinholes onto six separate areas of a sheet of CR-39 nuclear track detector. Each of the areas is covered by an aluminum range filter and records an image with a different lower bound on the ion energy. Subtracting images with adjacent cutoff energies results in images with upper and lower bounds on the ion energy. Ion images are read from the CR-39 with VERA, a fully-automatic, image-processor-based nuclear-track-counting system. Images of the Particle Beam Fusion Accelerator-II (PBFA-II) proton beam have been obtained and show

that the beam has been focused to achieve a horizontal FWHM of 5.7 mm and has delivered 18 kJcm^{3} to a target. 4 refs., 6 figs.

29785 **Sensitivity of electricity cost to heavy-ion fusion target characteristics.** Wilson, D.C.; Dudziak, D.J.; Magelssen, G.R.; Zuckerman, D.S.; Driemeyer, D.E. (Los Alamos National Lab., Los Alamos, NM 87545 (USA)). *Nuclear Technology;* **13**: No. 2, 333-338(Feb 1988).

The systems model for a commercial electric power facility produced by the Heavy-Ion Fusion System Assessment is used to study the sensitivity of electricity cost to various inertial confinement fusion target characteristics including gain, peak power, ion range, and target fabrication cost. Net electric power from the plant was fixed at 1000 MW(electric) to eliminate large effects caused by economies of scale. An improved target cost model is used and compared with earlier results. Although specific quantitative results changed, the earlier general conclusions remain valid. The system is moderately insensitive to target gain. A factor of 2.5 change in gain causes $<10\%$ change in electricity cost. Increased peak power needed to drive targets poses only a small cost risk but requires many more beamlets be transported to the target. Shortening the required ion range causes both cost and beamlet difficulties. A factor of 4 decrease in the required range at a fixed driver energy increases electricity cost by 43% and raises the number of beamlets from 34 to 330. Finally, the heavy-ion fusion system can accommodate large increases in target costs.

29786 **PBFA II ion diode theory and implications.** Vandevender, J.P.; Slutz, S.A.; Seidel, D.B.; Coats, R.S.; Miller, P.A.; Mendel, C.W. Jr.; Quintenz, J.P. (Sandia National Labs., Albuquerque, NM (USA)). *Laser and Particle Beams;* **5**: 439-449(Aug 1987). (CONF-8606131—).

From 2. international topical symposium on ICF research by high-power beams; Nagaoka, Japan (16 Jun 1986).

Fully electromagnetic, relativistic, two-dimensional, particle-in-cell (PIC) simulations of barrel-type and extractor-type Applied-B ion diodes have increased confidence in the design of present and future diodes for the Particle Beam Fusion Accelerator II (PBFA II). In addition, the data from various experiments on Proto I, Proto II, and PBFA I Applied-B ion diodes are inconsistent with previous models of diode operation, based on anode-cathode gap closure from expanding plasmas. A new model has been devised and applied to the PBFA II diode to explain the diode impedance and its time history, and to suggest methods for controlling the impedance.

29787 **Preliminary design of a $\simeq$ 10 MV ion accelerator for HIF research.** Fessenden, T.J.; Celata, C.M.; Faltens, A. (Lawrence Berkeley Lab., CA (USA)). *Laser and Particle Beams;* **5**: 457-463(Aug 1987). (CONF-8606131—).

From 2. international topical symposium on ICF research by high-power beams; Nagaoka, Japan (16 Jun 1986).

An experiment to study the physics of merging and of focusing ion beams is under development at the Lawrence Berkeley Laboratory. In this design, parallel beams of ions (C^{+}, Al^{+}, or Al^{++}) are accelerated to several MV and merged transversely. The merged beams are then further accelerated and the growth in transverse and longitudinal emittance is determined for comparison with theory. The completed apparatus will be used to study problems associated with focusing ion beams to a small spot as required for heavy ion fusion. Details of the accelerator design and considerations of the physics of combining beams are presented.

29788 **Directions for reactor target design based on the U.S. Heavy Ion Fusion Systems Assessment.** Wilson, D.C.; Dudziak, D.; Magelssen, G.; Zuckerman, D.; Driemeyer, D. (Los Alamos National Lab., NM (USA);McDonnell Douglas Astronautics Co., St. Louis, MO (USA)). *Laser and Particle Beams;* **5**: 517-524(Aug 1987). (CONF-8606131—).

From 2. international topical symposium on ICF research by high-power beams; Nagaoka, Japan (16 Jun 1986).

The Heavy-Ion Fusion Systems Assessment project is nearing completion and the resulting system model will be used to set directions for future target design work. Major uncertainties in target design were studied using the cost of electricity as a figure of merit. The heavy ion fusion system can accommodate large increases in target costs. Target design should concentrate on requirements for ion range and peak driver power.

29789 **Summary: Pt. 1. Experiments.** Vandevender, J.P. (Sandia National Labs., Albuquerque, NM (USA)). *Laser and Particle Beams;* **5**: 549-550(Aug 1987). (CONF-8606131—).

From 2. international topical symposium on ICF research by high-power beams; Nagaoka, Japan (16 Jun 1986).

A review is given of experimental projects related to inertial confinement devices. (U.K.).

29790 **Fusion technology 1986.** Elmsford, NY; Pergamon Books Inc. (1987). 1890p. (CONF-860917—). Pergamon Books Inc., Manager/Publishing Services, Maxwell House, Fairview Park, Elmsford, NY 10523.

From 14. SOFT - symposium on fusion technology; Avignon, France (8 Sep 1986).

The proceedings of the 14th symposium on Fusion Technology contain discussions on first wall, divertor, limiter and vacuum technology; power supplies and heating systems; blanket technology; safety; tritium handling; magnet technology; and data acquisition and control systems.

29791 **Ceramic tritium breeder materials-promise and performance.** Johnson, C.E.; Hollenberg, G.W. (Argonne National Lab., Argonne, IL 60439 (US)). pp 1249-1254 of Fusion technology 1986. Elmsford, NY; Pergamon Books Inc. (1987). (CONF-860917—).

From 14. SOFT - symposium on fusion technology; Avignon, France (8 Sep 1986).

A critical element in the D-T fusion reactor design is the tritium-producing blanket. The lithium-containing ceramic materials Li_2O, γ-$LiAlO_2$, Li_4SiO_4, and Li_2ZrO_3 are being strongly considered as candidates for producing tritium. Materials properties data are being collected to provide a basis for evaluation and selection of a prime candidate material.

29792 **The tara 24 mva magnet system.** Gandreau, M.P.J.; Shuster, M.S.; Berkman, V.J.; Thomas, P. (Plasma Fusion Center, Massachusetts Institute of Technology, Cambridge, MA 02139 (US)). pp 1749-1758 of Fusion technology 1986. Elmsford, NY; Pergamon Books Inc. (1987). (CONF-860917—).

From 14. SOFT - symposium on fusion technology; Avignon, France (8 Sep 1986).

Power transmission, conversion control, and regulation aspects of the Tara tandem mirror 24 mva magnet system are discussed in detail. The magnet coil set, magnetic field configuration and support vacuum chamber are described. It is shown that a complete turn key pulse magnet power system has been built for under $21/kW.

29793 **TFTR control systems for protection and for normal control of magnetic field coils.** Woolley, R.D. (Plasma Physics Lab., Princeton Univ., Princeton, NJ 08544 (US)). pp 1623-1630 of Fusion technology 1986. Elmsford, NY; Pergamon Books Inc. (1987). (CONF-860917—).

From 14. SOFT - symposium on fusion technology; Avignon, France (8 Sep 1986).

Early in 1987, the TFIR's magnetic field system will be upgraded. The planned improvements concentrate on improving the ability to inductively drive plasma currents, both by increasing the number of turns in the Ohmic Heating (OH) coil system through an external reconnection of existing coils, and by increasing the OH operating current swing. The most novel aspect of this upgrade is the new Coil Protection Calculator, which will allow operation of coils up to the maximum levels possible without exceeding coil stress limits. Other changes include increases in OH coil power supply current, voltage, and energy capabilities.

29794 Operation of an RFP with a thin, segmented shell. Schmid, P.; Robertson, S. (Univ. of Colorado, Boulder, CO 80309-0391 (US)). pp 107 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

The Reversatron RFP (R/a = 50 c/8 cm) has been operated with a shell of 0.4 mm aluminum. This shell is split in the equatorial plane is cut every 20° toroidally. The time for penetration of the vertical field is found by measurement to be 44 μsec. Data from discharges with no shell or a 2 cm thick aluminum shell show that discharges with no shell are shorter in duration (240 μsec) than those with the thick shell (400 μsec) and with no shell the plasma resistance rises more rapidly during the discharge. An array of magnetic position probes shows vertical and horizontal motion of the plasma column consistent with global MHD modes of small toroidal mode number. Discharges with the segmented shell have a higher plasma current (24 kA) than discharges with no shell (18 kA) and are longer in duration (280 μsec). The toroidal flux is also increased and the pinch parameter Θ is unchanged at 1.6 +- 0.3. The signals from the magnetic probe array are approximately doubled in amplitude; however, these signals are no loner simply related to the plasma displacement. The probes are located between the metal bellows and the thin shell and thus measure fields due to both plasma current and image currents in the shell. A mode analysis of these signals is being performed.

29795 Pneumatic pellet injectors for TFTR and JET. Combs, S.K.; Milora, S.L. (Oak Ridge National Lab., P.O. Box Y, Oak Ridge, TN 37831 (US)). pp 1375-1380 of Fusion technology 1986. Elmsford, NY; Pergamon Books Inc. (1987). (CONF-860917—). Contract AC05-84OR21400.

From 14. SOFT - symposium on fusion technology; Avignon, France (8 Sep 1986).

This paper describes the development of pneumatic hydrogen pellet injectors for plasma fueling applications on the Tokamak Fusion Test Reactor (TFTR) and the Joint European Torus (JET). The performance parameters of these injectors represent an extension of previous experience and include pellet sizes in the range 2-6 mm in diameter and speeds approaching 2 km/s. Design features and operating characteristics of these pneumatic injectors are presented.

29796 A four cavity, high harmonic gyro-klystron amplifier. Furuno, D.S.; McDermott, D.B.; Cao, H.; Kou, C.S.; Luhmann, N.C. Jr.; Vitello, P.; Ko, K. (Electrical Engineering Dept., Univ. of California, Los Angeles, CA 90024 (US)). pp 39 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

In this device, a relativistic, rotating shell of electrons interacts synchronously with a high-order azimuthal, cylindrical cavity TE mode. The gain of the fifth harmonic GK amplifier has been increased by doubling the length of the drift tubes. The theoretical enhancement is 18 dB (2⁵) beyond the previously measured gain of 29 dB. Also, coupling between cavities has been drastically reduced by removing 75% of the drift tube wall, thereby allowing higher gain operation before the onset of oscillation due to feedback. The output power level has increased by almost two orders of magnitude to 0.5 kW, corresponding to a conversion efficiency of 3%. Analytic theory and simulation results are compared to experimental data.

29797 Experimental design of the University of Maryland's high power, x-band gyroklystron. Calame, J.; Lawson, W.; Latham, P.E.; Read, M.; Striffler, C.D.; Wang, W.; Granatstein, V.L.; Welsh, D. (Univ. of Maryland, College Park, MD 20742 (US)). pp 39 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

In this paper the authors discuss a high peak-power, 1-2 μs, 10 GHz gyroklystron experiment that is nearing the operational stage at the University of Maryland. The device is expected to achieve power levels in excess of 30 MW via the interaction between a 500 kV, 160 A small-orbit beam and a $TE_{01}{}^{0}$ gyroklystron circuit. Additional characteristics include an efficiency in excess of 40%, a gain in excess of 50 dB, and low phase noise. The authors present the detailed theoretical design of a four-cavity, stagger-tuned microwave circuit. A parametric characterization of the design is carried out with the aid of a partially self-consistent numerical code. Also presented are the results of a start oscillation calculation for the exact cold cavity field profiles of all relevant modes.

29798 Efficiency enhancement by using depressed collector techniques in devices employing gyrating electron beams. Singh, A.; Chojnacki, E.P.; Destler, W.; Goutos, D.; Granatstein, V.L.; Lawson, W.; Striffler, C.D. (Univ. of Maryland, College Park, MD 20742 (US)). pp 40 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

This presentation deals with energy recovery from the spent beam in a large orbit gyrotron. Energy recovery is of special interest where intrinsic efficiency is relatively low, as for harmonic operation. The approach involves conversion of the rotational velocity of the beam after rf interaction, into axial velocity, and then collecting the beam particles on electrodes at depressed potentials.

29799 High power B.W.O. experiments. Shiffler, D.; Kerslick, G.; Nation, J.A. (Lab. of Plasma Studies and School of Electrical Engineering, Cornell Univ., Ithaca, NY 14853-5401 (US)). pp 40 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

Experiments are reported describing the performance characteristics, including wave coherence, of a high power Backward Wave Oscillator. The oscillator is powered by a 1 MeV, 1-3 kA electron beam. The authors report also on cold structure experiments designed to study extraction of the microwave energy from the injector end of the device. Preliminary experiments and design characteristics for forward wave amplifiers are presented.

29800 A study of pellet fueling for DIII-D. Schissel, D.P.; Jackson, G.L. (Technologies Inc., San Diego, CA 92130 (US)). pp 30 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

A study of pellet fueling on DIII-D has been undertaken with the primary objective of selecting the pellet injector (pellet size and speed) that is best suited for experiments on the DIII-D tokamak. These ablation models are compared to experimental results obtained on Doublet III. Preliminary results indicate that the Houlberg model satisfactorily predicts pellet penetration during Doublet III ohmic discharges, but predicts penetrations that are not as deep as experimentally observed in Doublet III neutral beam heated discharges. Comparisons of both models to Doublet III experimental results are shown, as well as ablation rates for a variety of DIII-D plasmas, pellet sizes, and velocities. The latter determines the optimum pellet injector for the DIII-D tokamak.

29801 Transport of low-energy, high-brightness H^- beams. Reiser, M.; Chang, C.R.; Wangler, T.P.; Neuschaefer, G.H. (Lab. for Plasma and Fusion Energy Studies, Univ. of Maryland, College Park, MD 20742 (US)). pp 28 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

The transport of High-Brightness H^- Beams from the ion source to the radio-frequency quadrupole (RFQ) accelerator requires solutions of several physics and engineering problems to avoid particle losses and emittance growth. Practical design considerations (such as electrical breakdown) limit ion-source voltages to about 20-50 kV while RFQ acceptance requires beam energies above 100 keV. Thus acceleration in an electrostatic column is required to increase the energy of the beam emitted from the ion source. Beam transport between source and column is usually accomplished by taking advantage of charge neutralization by background gas.

29802 **Plasma based high energy accelerators.** Katsouleas, T.C. (Univ. of California, Los Angeles (US)). pp 43 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

The subject of plasma-based high energy accelerators is emerging as an exciting new area of plasma science research. Accelerators at the frontier of high energy physics have reached enormous proportions (tens of kilometers). To reach yet higher energies will require even larger devices unless new technologies capable of larger accelerating gradients can be developed. Conventional accelerators are limited by electrical breakdown to accelerating fields of order MeV/cm. However, fully ionized plasmas are immune from breakdown and can support extremely large electric fields. It is then natural to consider a plasma's potential for providing ultra-high gradient acceleration.

29803 **A vircator amplifier.** Sze, H.; Benford, J.; Fittinghoff, D.; Harteneck, B.; Price, D.; Woo, W. (Physics International Co., San Leandro, CA 94577 (US)). pp 38 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

A cavity vircator has demonstrated that formation of a virtual cathode in a cavity can improve microwave production efficiency and narrow the radiation bandwidth. When the virtual cathode radiates the microwave fields grow from noise. For each cavity, there is only one or a limited number of allowable modes for a given frequency. In this paper, a novel device - a vircator amplifier is described. The device consists of a relativistic magnetron and a cavity vircator with both devices powered by a 1 MeV, 3 Ω, 65 ns FWHM pulser. The idea is to inject a signal from the magnetron before and during virtual cathode formation in a cavity. The injected signal should lock the frequency and enhance electron bunching and therefore improve efficiency further. Experiments underway to evaluate the amplifier operating characteristics are discussed. The applicability of vircator amplifiers to the next generation of high-power microwave devices are addressed.

29804 **Preliminary results from a reflex diode experiment on the Aurora intense pulsed relativistic electron beam generator.** Bromborsky, A.; Kehs, R.A.; Huttlin, G.A.; Graybill, S.E.; Still, G.W.; Clark, M.C.; Bartsch, R.; Davis, H.A.; Sherwood, E.; Thode, L.E. (US Army LABCOM, Harry Diamond Labs. (US)). pp 39 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

The electron beam output from one of the Aurora transmission lines (200 kA, 8 MV, 150 ns) was used to drive a reflex diode microwave generator. Simulations of this system with the 2 1/2 dimensional particle in cell code predicted that peak microwave powers in excess of 50 GW would be produced. In the experiment the total microwave energy generated by the reflex diode was measured to be about 1 kJ with a wire calorimeter. Additionally, a small fraction of the microwave output was extracted with two radial rectangular waveguides. The total duration of the microwave output was 50 ns. Correlating the results from these measurements implies an average microwave output power during the pulse of 20 GW and a time-averaged microwave conversion efficiency of 1 to 2%.

29805 **Self-sustained, high current density, high pressure diffuse discharge characteristics.** Piejak, R.B. (GTE Labs. Inc., 40 Sylvan Rd, Waltham, MA 02254 (US)). pp 113 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

Discharge current and voltage have been measured in UV preionized, high current density, high pressure diffuse discharges. The discharge voltage and current measurements were made in N_2 with a tri-n-propylamine (TPA) seedant and in three CO_2:N_2(wTPA):He mixtures:1:2:3, 1:7:30, and 1:7:0 at gas pressures of 760, 610, 410, and 250 torr. Discharges with cross sections of 11.4 and 5 cm^2 were studied. The peak discharge current density ranged between 80 to 350 $ampcm^2$ with a duration of 200 ns full width at half maximum. At peak current density the JP varied between 0.1 and 1.4 $ampcm^2torr$. EP was calculated assuming a constant electrode voltage drop. The JP, discharge resistance, energy dissipated in the discharge, charge flow, time derivative of the discharge current, drift velocity and electron density have also been calculated.

29806 **Behavior of graphites under intense heat loads.** Bohdansky, J.; Croessmann, C.D.; Linke, J. (Sandia National Labs., Fusion Technology Div. 6248, P.O. Box 5800, Albuquerque, NM 87185 (US)). pp 1063-1068 of Fusion technology 1986. Elmsford, NY; Pergamon Books Inc. (1987). (CONF-860917—).

From 14. SOFT - symposium on fusion technology; Avignon, France (8 Sep 1986).

Today, graphite is used in most tokamak experiments as first wall material (e.g., limiters, collector plates, amor-tiles) due to its excellent thermal shock resistance, low-Z mass, and high sublimation temperature. On the other hand, due to the high porosity gas absorption can create a severe problem. Besides outgassing, chemical erosion and sublimation can also contribute to impurity introduction into the plasma. In this experiment the behavior of graphitic materials (fine-grain reactor grade graphites, carbon fiber composite materials, etc.) have been tested under high heat loads. More emphasis was laid on the following aspects: thermomechanical properties (cracking behavior); thermal erosion behavior (weight loss, surface modifications); and outgassing behavior (25 - 1600°C).ses

29807 **Coupling between eddy current and deflection in cantilevered beams in magnetic fields.** Hua, T.Q. Seattle, WA; Univ. of Washington (1986). 162p. University Microfilms Order No. 87-06,588.

Thesis (Ph. D.).

Experiments were performed to investigate the coupling between eddy currents and deflection in cantilevered beams in longitudinal and transverse magnetic fields. This coupling effect reduces the current, deflection, and material stress to levels far less severe than would be predicted if coupling is disregarded. The experiments were conducted using the FELIX (Fusion ELectromagnetic Induction experiment) facility at the Argonne National Laboratory. The beams, which provide a simple model for the limiter blades in a tokamak fusion reactor, are subjected to crossed time-varying and constant magnetic fields. The time-varying field simulates the decaying field during a plasma disruption and the constant field models the toroidal field. Several test pieces are employed to allow variations in thicknesses and mechanical and electrical properties. Various magnetic field levels and decay time constants of time-varying are used to study the extent of the coupling from weak to strong coupling. The ratios of constant field to time-varying field are kept in the range from 10:1 to 20:1 as would be appropriate to tokamak limiters. Major parameters measured as functions of time are beam deflection, measured with an electro-optical device; total circulating current, measured with a Rogowski coil; strain recorded by strain gauges; and magnetic fields measured with Hall probes.

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9901 Management

29808 (OEFZS—4405e) Report 1986 - abridged version. Schwach, G.W. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. Stabsabteilung Forschungsplanung und Technologieprognose). (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H.). Jan 1988. 33p. (FO—38/88). NTIS (US Sales Only), PC A03/MF A01 - Translated by Pokorny, E. . Order Number DE88702616/JAW.

This is a non-technical progress report (in English) of the activities of the Research Centre Seibersdorf in the fields of Energy and Safety, Materials Research, Isotope and Radiation Techniques, Environment Protection, Health and Food and Industrial Consulting. (qui).

9902 Mathematics And Computers

REFER ALSO TO CITATION(S) 28971

29809 (AD-A—188507/8/XAB) Low-cost mobile robot. Final report, April-October 1987. Evans, J.M. (Transitions Research Corp., Hartford, CT (USA)). 7 Oct 1987. 49p. (SBIR—87-3). NTIS, PC A03/MF A01.

In the 1986 SBIR solicitation, DARPA identified a need for a low-cost mobile robot for laboratory research use. This report covers the work by Transitions Research Corporation in addressing this opportunity under a Phase I SBIR contract. TRC has developed technical requirements and selected a vehicle design, a trajectory control system, and a communications system to meet those requirements. Use of a common research vehicle base would reduce the time and cost to carry out experiments in navigation of autonomous mobile vehicles, would expedite sharing and comparing of research results, and would advance the understanding of the evolution of artificial intelligence.

29810 (BNL—40839) Applications of fault tree analysis to the design process. Youngblood, R.W. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 10p. (CONF-880112—1).

From Photovoltaics safety conference; Denver, CO, USA (19 Jan 1988).

Fault tree analysis of a system can provide a complete characterization of system failure modes, i.e., what combinations of component failures can give rise to system failure. This can be applied to the design process at several levels: confirmatory analysis, in which a fault tree development is used to verify design adequacy, importance analysis, in which fault tree analysis is used to highlight system vulnerabilities, and design optimization, in which fault tree analysis us uwsed to pick the least expensive configuration from a collection of possibilities satisfying a given constraint. Experience shows that the complexity of real systems warrants the systematic and structured development of fault trees for systems whose failure can have severe consequences. 17 refs.

29811 (CONF-880117—2) A concurrent neural network algorithm for the traveling salesman problem. Toomarian, N. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 9p.

From 3. conference on hypercube concurrent computers and applications; Pasadena, CA, USA (19 Jan 1988).

A binary neuromorphic data structure is used to encode the N-city Traveling Salesman Problem (TSP). In this representation the computational complexity, in terms of number of neurons, is reduced from Hopfield and Tank's $0(N^2)$ to $0(N \log_2 N)$. A continuous synchronous neural network algorithm in conjunction with the Lagrange multiplier, is used to solve the problem. The algorithm has been implemented on the NCUBE hypercube multiprocessor. This algorithm converges faster and has a higher probability to reach a valid tour than previously available results. 22 refs., 3 figs., 2 tabs.

29812 (CONF-880569—1) Robot navigation using simple sensor fusion. Jollay, D.M.;Ricks, R.E. (Tennessee Univ., Knoxville (USA); Tennessee Univ., Chattanooga (USA)). [1988]. Contract AC05-84OR21400. 22p.

From Spring decus; Cincinnati, OH, USA (16 May 1988).

Sensors on an autonomous mobile system are essential in enviornment determination for navigation purposes. As is well documented in previous publications, sonar sensors are inadequate in providing a depiction of a real world environment and therefore do not provide accurate information for navigation, it not used in conjunction with another type of sensor. This paper describes a simple, inexpensive, and relatively fast navigation algorithm involving vision and sonar sensor fusion for use in navigating an autonomous robot in an unknown and potentially dynamic environment. Navigation of the mobile robot was accomplished by use of a TV camera as the primary sensor. Input data received from the camera were digitized through a video module and then processed using a dedicated vision system to enable detection of obstacles and to determine edge positions relative to the robot. Since 3D vision was not attempted due to its complex and time consuming nature, sonar sensors were then sued as secondary sensors in order to determine the proximity of detected obstacles. By then fusing the sensor data, the robot was able to navigate (quickly and collision free) to a given goal, achieving obstacle avoidance in real-time.

29813 (EPRI-NP—5641-SR, pp 1.3.1-1.3.16) Digital's progress in open systems interconnect. Jennings, D. (Digital Equipment Corp., San Francisco, CA (USA)). Feb 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920217/JAW. (CONF-8608110—).

From Seminar on integrated power plant computer communications; San Francisco, CA, USA (25 Aug 1986).

This paper describes four products of Digital Equipment Corporation and their commitment to an open systems interconnect standard. These products are: a) the OSI Transport Layer for VAX/VMS which facilitates task-to-task communications between a program running under VAX/VMS and a program running other vendors systems; b) the CCITT x.400 Message Handling System which facilitates electronic message interchange among the world's public communications carriers, and between vendors, carriers, and private message networks; c) a modification of the VAX PSI product to support the 1984 CCITT x.25 recommendations; and d) the MAP (manufacturing automation protocol) version 2.1 for VAX/VMS.

29814 (EPRI-NP—5641-SR, pp 1.4.1-1.4.15) UNIX in real time. Parkman, P. (MASSCOMP, San Jose, CA (USA)). Feb 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920217/JAW. (CONF-8608110—).

From Seminar on integrated power plant computer communications; San Francisco, CA, USA (25 Aug 1986).

This paper examines the suitability of UNIX as a Real Time Operating System. Classical real time systems can be described in terms of seven features, or requirements. Of these seven, standard UNIX meets or comes close to meeting five. Extensions and modifications have been made to meet the other two requirements. With suitable modifications, UNIX is shown to be a very good real time operating system. Further changes might make it better still.

29815 (EPRI-NP—5641-SR, pp 1.5.1-1.5.13) Application of fiber optics to local area networks. Bender, A.D. (FiberCom, Inc., Roanoke, VA (USA)). Feb 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920217/JAW. (CONF-8608110—).

From Seminar on integrated power plant computer communications; San Francisco, CA, USA (25 Aug 1986).

Fiber optic technology can provide performance and cost benefits in local area networks today, while on-going standards activities point to all fiber optic networks in the future. If you are currently planning a local area network, fiber optics should be considered for the media. Not only can fiber optics provide near term benefits, but it will also enable growth to future high speed networks without the need for costly replacement of the transmission media.

29816 (EPRI-NP—5641-SR, pp 2.1.1-2.1.8) **TOP (Technical and Office Protocols): an overview.** Bride, L. (Boeing Computer Services, Seattle, WA (USA)). Feb 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920217/JAW. (CONF-8608110—).

From Seminar on integrated power plant computer communications; San Francisco, CA, USA (25 Aug 1986).

TOP (Technical and Office Protocols) is a specification built on national and international standards used to specify functional networks for distributed information processing in technical and business office environments. The goal and intent of TOP is to establish a specification for data communications and information exchange in multi-vendor technical and office networks. TOP will provide a general, non-proprietary, solution to the multi-vendor networking problem and will hasten the development and acceptance of international standards and conforming products. These products can include intelligent terminals, servers and other computing resources. TOP specifies the protocol options and parameters to minimize vendor risk and ensure compatibility. TOP's scope also includes provisions to interconnect multiple local and wide area networks.

29817 (EPRI-NP—5641-SR, pp 2.2.1-2.2.2) **DESIGNet: an AI approach to network design.** Zaiontz, C. (BBN Communications, Cambridge, MA (USA)). Feb 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920217/JAW. (CONF-8608110—).

From Seminar on integrated power plant computer communications; San Francisco, CA, USA (25 Aug 1986).

This presentation describes BBN Communications' efforts in designing wide area networks. The author discusses the network design process, and summarizes why network design poses such difficult technical problems. He then describes DESIGNet, an intelligent system used to design networks, under development at BoH Beranek and Newman Communications Corporation.

29818 (EPRI-NP—5641-SR, pp 2.3.1-2.3.14) **NBS program in open system interconnection (OSI).** Blanc, R.P.; Mills, K.L. (National Bureau of Standards, Gaithersburg, MD (USA)). Feb 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920217/JAW. (CONF-8608110—).

From Seminar on integrated power plant computer communications; San Francisco, CA, USA (25 Aug 1986).

Since 1979 the NBS has engaged in a program to advance the concept of open systems interconnection (OSI). The program led to available vendor products for many OSI protocols; to adoption of the OSI standards by General Motors and Boeing; to plans by the Department of Defense to migrate toward OSI protocols. Work remains in two major areas. First, government users who stand to benefit by adopting OSI standards must be given the assistance required to effectively apply the standards and vendor products complying with the standards. Second, research is needed to fill gaps that exist within the available OSI standards. One gap is the lack of network management facilities for the OSI environments. A second gap is the minimal set of application protocols designed to work within a distributed systems environment. A third gap is the inability of the present OSI protocols to meet specific functional and performance requirements for real-time process control applications. A fourth gap is the inadequate treatment of security requirements. NBS has now directed its OSI program toward assistance to government users and toward research to fill the gaps remaining within the OSI standards. The present paper provides an overview of these new directions and gives some perspective on the past successes of the NBS program in OSI.

29819 (EPRI-NP—5641-SR, pp 2.5.1-2.5.14) **Multimedia mail system for office automation.** Garcia-Luna-Aceves, J.J.; Craighill, E.J.; Poggio, A. (SRI International, Menlo Park, CA (USA)). Feb 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920217/JAW. (CONF-8608110—).

From Seminar on integrated power plant computer communications; San Francisco, CA, USA (25 Aug 1986).

Computer mail represents a major component of office automation; today, computer mail systems that handle text messages are common place in several academic, industrial, and military sites in developed countries. However, people need to have information in forms other than text in their daily activities. The electronic interchange of information represented in different media is becoming increasingly important as computers are becoming a common tool in all sectors of society, and in office environments in particular. In this paper, a distributed multimedia mail system is described that allows exchanging compound multimedia documents among heterogeneous workstations. The SRI system has been operational for a number of years and is interconnected with the mail systems of other research centers using the multimedia mail protocols currently defined for the DARPA Internet.

29820 (EPRI-NP—5641-SR, pp 2.6.1-2.6.14) **Open systems computing: network services and servers.** Gortner, C.W. (Sun Microsystems, Inc., Mountain View, CA (USA)). Feb 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920217/JAW. (CONF-8608110—).

From Seminar on integrated power plant computer communications; San Francisco, CA, USA (25 Aug 1986).

Open systems computing is a concept of using a system built of components that obey interconnection standards. Sun is leading the evolution of the computing environment towards advanced heterogeneous networking schemes where specialized compute facilities may be purchased from a number of vendors and integrated onto a network. Whether it be transparent file access or a distributed computing application, the user does not need specialized network knowledge. From the organization's point of view, old equipment can finally be connected and new equipment integrated. NFS, an emerging industry standard, is a transparent file access service for constructing an integrated multi-vendor network. Over 80 organizations have adopted NFS as their transparent file access service for networks. REX is a network tool for distributing discrete job steps in computing. REX uses NFS to transparently access files and duplicates the content of the current working environment on a remote machine. With the growing sophistication of many types of applications (such as simulation and modeling), very large shared machines can be coupled with workstations such that the batch process routine on a central compute server can be accessed seemingly interactively from a workstation. An example is using a high performance compute server to accelerate a power transmission simulation. A model is built on the workstation with interactive procedures. This same model can then be accessed by the mini supercomputer which crunches through the analysis. Display of the results are processed on the workstation for subsequent interpretation. The promise of open systems computing and a networked homogeneous computing environment is a choice of vendors for workstations and network servers.

29821 (EPRI-NP—5641-SR, pp 3.4.1-3.4.18) **Integration of communications with the intelligent gateway processor.** Hampel, V.E. (Lawrence Livermore National Lab., CA (USA)). Feb 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920217/JAW. (CONF-8608110—).

From Seminar on integrated power plant computer communications; San Francisco, CA, USA (25 Aug 1986).

The Intelligent Gateway Processor (IGP) software is being used to interconnect users equipped with different personal computers and ASCII terminals to mainframe machines of different make. This integration is made possible by the IGP's unique user interface and networking software. Prototype systems of the table-driven, interpreter-based IGP have been adapted to very different programmatic requirements and have demonstrated substantial increases in end-user productivity. Procedures previously requiring days can now be carried out in minutes. The IGP software has been under development by the Technology Information Systems (TIS) program at Lawrence Livermore National Laboratory (LLNL) since 1975 and has been in use by several federal agencies since 1983. The Air Force is prototyping applications which range from automated identification of spare parts for aircraft to office automation and the controlled storage and distribution of technical orders and engineering drawings. Other applications of the IGP are the Information Management System (IMS) for aviation statistics in the Federal Aviation Administration (FAA), the Nuclear Criticality Information System (NCIS) and a nationwide Cost Estimating System

(CES) in the Department of Energy, the library automation network of the Defense Technical Information Center (DTIC), and the modernization program in the Office of the Secretary of Defense (OSD). 31 references.

29822 (EPRI-NP—5641-SR, pp 3.5.1-3.5.8) **Implementation of the intelligent gateway processor using UNIX.** Berch, M.C. (Lawrence Livermore National Lab., CA (USA)). Feb 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920217/JAW. (CONF-8608110—).

From Seminar on integrated power plant computer communications; San Francisco, CA, USA (25 Aug 1986).

The Technology Information Systems (TIS) Program at Lawrence Livermore National Laboratory, jointly sponsored by several government agencies, has implemented a new approach to systems interconnection and user interfaces. The Intelligent Gateway Processor (IGP) is an integrated package designed to provide a single user interface to a variety of systems, automate access to information resources, and provide audit logging and authorization controls. The IGP software is UNIX-based, but the IGP approach is applicable to any heterogeneous environment. This paper discusses the implementation of the IGP software: why UNIX was chosen (and retained); the role of the individual IGP modules; how they were written to fit into (and improve on) the UNIX concept; and plans for the future of the IGP concept.

29823 (LA-UR—87-3090) **A graphical, intelligent interface for discrete-event simulations.** Michelsen, C.; Dreicer, J.; Morgeson, D. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 8p. (CONF-880516—2). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88000522/JAW.

From Computer human interaction conference; Washington, DC, USA (15 May 1988).

This paper will present a prototype of anengagement analysis simulation tool. This simulation environment is to assist a user (analyst) in performing sensitivity analysis via the repeated execution of user-specified engagement scenarios. This analysis tool provides an intelligent front-end which is easy to use and modify. The intelligent front-end provides the capabilities to assist the use in the selection of appropriate scenario value. The incorporated graphics capabilities also provide additional insight into the simulation events as they are {open←quotes}unfolding.{closing←quotes} 4 refs., 4 figs.

29824 (N—88-17206, pp vp) **Performance analysis of parallel branch and bound search with the hypercube architecture.** Mraz, R.T. Oct 1987. NTIS, PC A23/MF A01. (NASA-CP—2491; S—567; NAS—1.55:2491; CONF-8708251—).

From 1. annual workshop on space operations automation and robotics (SOAR 87); Houston, TX, USA (5 Aug 1987).

With the availability of commercial parallel computers, researchers are examining new classes of problems which might benefit from parallel computing. This paper presents results of an investigation of the class of search intensive problems. The specific problem discussed is the Least-Cost Branch and Bound search method of deadline job scheduling. The object-oriented design methodology was used to map the problem into a parallel solution. While the initial design was good for a prototype, the best performance resulted from fine-tuning the algorithm for a specific computer. The experiments analyze the computation time, the speed up over a VAX 11/785, and the load balance of the problem when using loosely coupled multiprocessor system based on the hypercube architecture.

29825 (PNL-SA—15670) **Knowledge based systems in nondestructive evaluation.** Melton, R.B. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1987. Contract AC06-76RL01830. 7p. (CONF-8708225—1).

From NATO advanced research workshop on signal processing and pattern recognition in nondestructive evaluation of materials; Quebec, Canada (19 Aug 1987).

This paper dicusses the application of knowledge based systems technology to problems in nondestructive evaluation (NDE). The Saft Image Interpretation Assistant (SIIA) is used as an illustrative example. SIIA is a prototype knowledge based system designed to assist in making the operation of the Synthetic Aperture Focusing Technique (SAFT) Ultrasonic Inspection System more reliable and efficient. The two primary motivations for developing SIIA were to insure that the SAFT system is used correctly and consistently and to assist in interpreting the results of a SAFT inspection. Our initial goal was to develop a system to assist in the interpretation of the images resulting from a SAFT inspection. As we started to identify the structure of the inspection problem, however, we realized knowledge based system technology could be more effectively applied to develop a system that is in essence an on-line procedure generator that guides a user through a SAFT inspection. When fully developed such a system could assist in proper setup of the inspection equipment for each of the steps in a SAFT inspection and in interpreting the inspection results for each step. The first section of the paper describes the structure of the SAFT inspection problem. The next section discusses three forms of knowledge: procedural, structural, and inferential as they relate to the SAFT problem. The final section discusses the implications of this type of system for other NDE techniques and applications.

29826 (SOL—88-5) **Making progress during a stall in the simplex algorithm.** Dantzig, G.B. (Stanford Univ., CA (USA). Systems Optimization Lab.). Feb 1988. Contract FG03-87ER25028. 9p.

All the standard methods for avoiding cycling in the simplex algorithm set up a subprogram related to the blocking rows in the canonical form and look for an improving homogeneous solution. The method proposed in this paper does not. Instead, the Gass-Saaty parametric method applied to the objective (cost) form is used to choose the incoming column. The pivot-row choice among blocking rows, i.e., those tied for pivot, is arbitrary. A simple anticycling device is used which avoids dual degeneracy of the parameterized objective with probability one. Tests were run on nine highly degenerate practical test problems ranging in size from small to large. Using MINOS software, the standard simplex method required 31, 195 iterations of which 20,504 (or 66%) were blocked pivots. Using the parametic scheme required 14,379 iterations, of which 9,481 or 66% were also blocked. The reduction in the number of interactions for this set of highly degenerate test problems is over 50%. CPU time reduction under the current way of implementation is 40%. 5 refs.,

29827 **Butterfly barrier.** Brooks, E.D. III. (Lawrence Livermore National Lab., CA (USA)). *International Journal of Parallel Programming;* **15**: No. 4, 295-307(Aug 1986). Contract W-7405-ENG-48.

The authors distribute an algorithm for barrier synchronization that requires only read and write to shared store. The algorithm is faster than the traditional locked counter approach for two processors and has an attractive $\log_2 N$ time scaling for larger N. The algorithm is free of hot spots and critical regions and requires a shared memory bandwidth which grows linearly with N, the number of participating processors. They verify the technique using both a real shared memory multiprocessor, for numbers of processors up to 30, and a shared memory multiprocessor simulator, for number of processors up to 256.

29828 **Solution of sparse positive definite systems on a shared-memory multiprocessor.** George, A.; Heath, M.T.; Liu, J.; Ng, E. (Oak Ridge National Lab., TN (USA)). *International Journal of Parallel Programming;* **15**: No. 4, 309-325(Aug 1986). Contract AC05-84OR21400.

Algorithms and software for solving sparse symmetric positive definite systems on serial computers have reached a high state of development. In this paper, they present algorithms for performing sparse Cholesky factorization and sparse triangular solutions on a shared-memory multiprocessor computer, along with some numerical experiments demonstrating their performance on a Sequent Balance 8000 system.

29829 **Galerkin/Runge-Kutta discretizations for parabolic partial differential equations.** Keeling, S.L. Knoxville, TN; Univ. of Tennessee (1986). 333p. University Microfilms Order No. 87-01,801.

Thesis (Ph. D.).

Efficient, high-order Galerkin/Runge-Kutta methods are constructed and analyzed for certain classes of parabolic initial boundary-value problems. In particular, the partial differential equations considered are (1) semilinear, (2) linear with time dependent coefficients, and (3) quasilinear. Optimal-order error estimates are established for each case. Also, for the problems in which the time-stepping equations involve coefficient matrices changing at each time step, a preconditioned iterative technique is used to solve the linear systems only approximately. Nevertheless, the resulting algorithm is shown to preserve the optimal-order convergence rate while using only the order of work required by the base scheme applied to a linear parabolic problem with time-independent coefficients. Furthermore, it is noted that special Runge-Kutta methods allow computations to be performed in parallel so that the final execution time can be reduced to that of a low-order method.

9903 Information Handling

REFER ALSO TO CITATION(S) 28894, 28895, 28896, 28897, 29416

29830 (AD-A—188562/3/XAB) Assessment of DOD and industry networks for Computer-Aided Logistics Support (CALS) telecommunications. Final report. DeLaura, F.L.; Sharp, S.J.; Clark, R. (Logistics Management Inst., Bethesda, MD (USA)). Jun 1987. 150p. (LMI-AL—636R1). NTIS, PC A07/MF A01.

The Department of Defense is committed to applying the best in modern technology toward improving the transfer of design, engineering, and manufacturing technical information among weapon-system contractors and DoD organizations. The Military Services, the Defense Logistics Agency (DLA), the Defense Communications Agency (DCA), and industry are undertaking or planning telecommunications support for such transfer. In view of these many and diverse efforts, the Computer Aided Logistics Support (CALS) Steering Group through the CALS Communications Working Group has recognized the need for evaluating them. The report presents an evaluation of CALS-related telecommunications requirements in DoD, the major efforts for automating engineering drawing and technical data repositories, and various intelligent-gateway efforts in each of the Services. The overall direction within each Service for telecommunication support and transitioning to the OSI (Open Systems Interconnection) standards is presented, as well as the status of commercial efforts for defining and implementing the OSI standards and improving long-haul telecommunications support.

29831 (DOE/CE/90143—T1) [Technical and administrative support for the interagency advance power group and data]. (CSR, Inc., Washington, DC (USA)). Jul 1987. Contract AI01-84CE90143. 17p.

CSR, Incorporated has operated the PIC database and provided secretariat support to the IAPG since March 1984. PIC staff conducted a variety of tasks to support the objectives of the IAPG during this contract year. Tasks related to database maintenance included contacting project managers to update existing projects and register new ones;inputting and verifying information recorded in the database;reproducing and distributing briefs monthly;and publishing a semiannual listing of registered briefs. PIC staff provided secretariat support to the IAPG working group and panel chairpersons.

29832 Performance evaluation of the statistical aggregation by categorization in the SM3 system. Baru, C.K.; Su, S.Y.W. Gainesville, FL; University of Florida (1984). vp. Contract FG05-84ER13285.

To perform a statistical aggregation operation over a large file often requires that the records of the file be divided into categories based on the values of the attribute(s) over which some statistical computation is to be performed. It is rather inefficient to perform the necessary data transfer, categorization and statistical computation using a single processor. Parallel algorithms designed for multiprocessor systems have been proposed and their performance improvement over the conventional systems has been demonstrated. It is shown in this paper that three to four times performance improvement can be further gained by using a dynamically partitionable multicomputer system with switchable main memory modules (SM3). 34 references, 5 figures, 2 tables.